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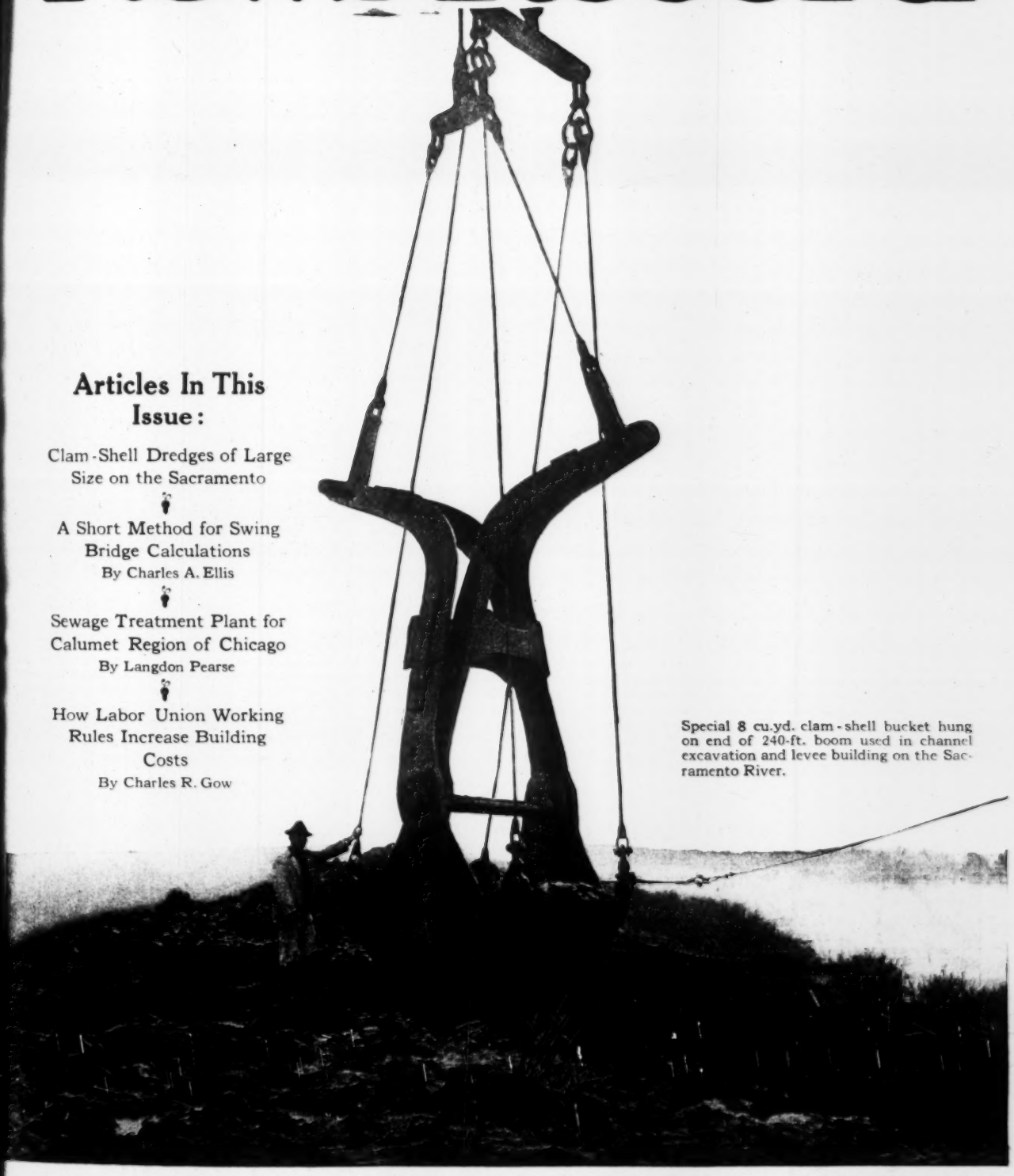

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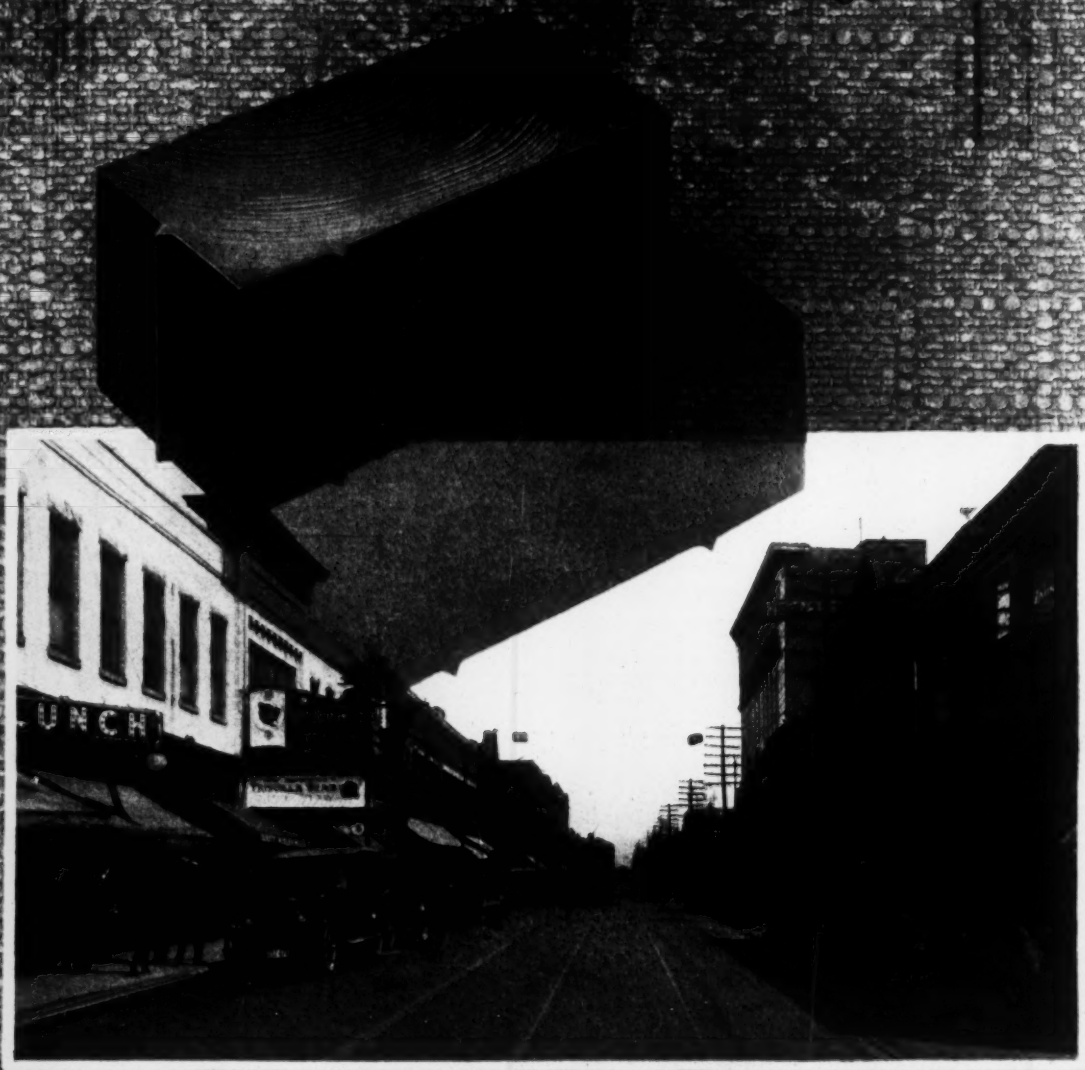

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 86 — NEW YORK, THURSDAY, JUNE 9, 1921 — Number 23

Storm and Flood

CENTRAL Colorado, flood stricken, is taking the toll of its victims as we go to press. Though loss of life and property destruction occurred mainly at Pueblo, second city of the state, the responsible causes involved a wide extent of territory, embracing much of the headwaters area of the Arkansas and the South Platte rivers. From present reports it appears that a large-area rainfall of great total depth was the originating cause of the flood. Such a storm visited Ohio and Indiana, in 1913, and in its devastation of the Miami valley cities it showed what damage may follow the conjunction of the enormous volumes of water represented by five to ten inches of precipitation extending over thousands of square miles. The engineering studies that followed the Miami flood showed these rainfalls to be rare, so rare indeed that we hardly have adequate data to measure the danger. If the detail reports show the Colorado storm to belong in this class of the epochal storms, it will add much to what we know about them, and through this better knowledge it will increase the effectiveness of the engineering works that must ultimately be the reliance against a recurrence of such flood disaster.

Engineers Recognized

THE Panama Canal is an engineering achievement, perhaps the best-known in the world today. For that reason the significance of the personnel of the just appointed Panama investigating commission may be lost by the general public. People are so accustomed to seeing engineers dealing with all projects on the Isthmus that most of them may not appreciate that the subject to be studied by the new board is one of administration or in the words of the preliminary report "how to make the Canal Zone more efficient and less expensive as a growing Government concern." The custom in the past too often has been to leave such questions to the lawyer, politician and business man. The Secretary of War in this case recognizes the rights and abilities of the engineering profession for he has appointed to the commission three engineers, two from the Government service, one from private practice, beside one man from the allied public utility field. The appointment is one of the most helpful recent signs of the progress of the profession.

New Outlook for Highway Thought

THE conference on highway traffic regulation held at Yale University two weeks ago, as described in the news columns of the last issue, emphasized the need for a new kind of thinking by state highway and municipal officials. Organized primarily to stimulate public interest in the general subject, with a view to securing more rational and effective legislation, a higher degree of public safety and a wise expenditure of road building funds, the meeting served the further end of indicating the enlarged scope of the problem which the highway administrator of today is facing. That problem, clearly reflected in the formal papers and the discussions at the conference, extends far beyond the narrow limits of design and construction details, to which engineers have been devoting their main effort during recent years, and reaches out into new fields of highway transport economics. In places this trend has been sensed and useful work is being done in studying volume and character of traffic as a basis for planning the location and type of new routes or the reconstruction of old ones, road classification and the designation of highways to form an interconnected state system, and motor vehicle legislation based on reasonable requirements as to weight, speed, and license fee, and similar topics. By and large, however, the great opportunity now at hand for the engineer to assume a position of leadership in the nation's thinking on highway matters and to mold road building policies along lines sound financially as well as technically is not being grasped. The country is just awakening to the importance of the highway as an essential agency in our industrial life. We have been passing through a period of road "boosting." Amid the clamor of the propagandists the highway engineer has not been heard. It is now his time to talk, and if we sense conditions correctly, the country, wearied with the band-wagon methods of "drives" for all manner of projects, is in a mood to grant the engineer a respectful audience, if he has a real message to deliver.

Governmental Co-ordination!

NEWS reports from Washington this week state that despite early opposition the Senate has authorized $35,000 for "scientific and technologic investigations concerning heavy clay products, cement, feldspar, slate and other non-metallics." This looks like characteristic Governmental lack of co-ordination. The sum is not very great but why divert it to another bureau, when the Bureau of Standards is already engaged in such studies? Some one should explain why two or three different branches of the Government should each be spending small amounts on cements and clays.

A Chance for Mare Island

POLITICAL rather than engineering considerations acted to defeat the initial appropriation for a huge naval base at Alameda, Cal., on the east shore of San Francisco Bay, but if the project is dead for this term of Congress it is to be hoped that in its revival the engineering factors will be more governing than they were in the selection of the site by the joint congressional committee. The relative advantages of Mare Island, where the yard now is, and the new sites on the Bay were stated in *Engineering News-Record*, Dec. 27,

1920, and it was then pointed out that the scrapping of Mare Island meant the virtual throwing away of millions of dollars in existing plant. This would be extravagant enough in ordinary times; just now it is almost criminal. If the Pacific Coast feels so strongly the need of additional naval insurance, it would do well to urge upon Congress the saving that would result if Mare Island were substituted for the site farther south on the bay.

Fortunate America

AMERICAN index numbers comparing present price conditions with those of 1913 range from 150 to 220, that is, they show increases of 50 to 120 per cent. If the United States had not entered the war, or if, in fact, the war had not occurred, it is probable that prices now would be at least 30 per cent higher than in 1913. This is indicated by the trends. Since the panic year of 1907 the cost of living has been rising, but it was the war that destroyed "normalcy" in this country, as elsewhere. Despite the recent improvement in business, the hopeful outlook and the determined effort that is being made to stabilize American industry, business conditions in the United States are still unsatisfactory. Both wholesale and retail prices have fallen sharply in the last four months. Nevertheless, the cost of living is still too high and the number of unemployed a serious factor. Facing the situation, it is as easy to be reasonably pessimistic. No special gift of sight is needed to see the cloud, but there is also the customary silver lining. For a contrast note the business conditions abroad. An index number of 200 gives occasion for congratulation, when compared with the index numbers of European countries. Italy's index number for wholesale prices in March, just received in this country, is 604 as compared with 1913, and 760.46 when referred to the old basis of 1901-1905. This means that present wholesale prices in Italy are approximately six times as high as in 1913. Conditions are better in England and France, it is true, but far worse in Germany and the remnants of Austria-Hungary. Contemplation of such a state of affairs demonstrates that the silver lining of American business is very bright indeed.

Freight Rates

WITH prices of construction materials coming down, and with labor being "deflated" in many sections of the country, stationary freight rates act as a counterweight against probable prosperity. In *Engineering News-Record* of March 3, p. 402, it was shown that the rates on finished steel products from Pittsburgh to New York or Chicago are 138 per cent in excess of those in effect in 1913. The base mill price of structural shapes is $2.20 per 100 lb., and the freight to either point is 38c. or 17 per cent of this price. In 1913, structurals cost $1.50, the freight being 16c. or about 10½ per cent. Proportioned on the 1913 basis, present freights would be not more than 24c. This would mean a reduction in carrying charges of $1,400 per 1,000 net tons. High freight rates are of course not confined to construction materials. They apply universally, to the detriment of all business. The car shortage of six months ago is not forgotten; it is made the more memorable by the fact that at present some half-million freight cars are lying idle. Senator Capper recently called attention to this situation, warning the railroads that unless a "live-and-let-live" policy were adopted by them, a return to government operation was inevitable. He stated that until a few weeks ago the chief railroad system in the United States was losing $250,000 per day in reduced traffic. "It is expensive for everybody," he said. "The way out is to encourage the people to use the railroads by making it possible for them to ship goods and to travel; to give business a chance to create more business." To which statement we heartily agree—but we add, "Railroad wages must first be reduced, and the monstrous national agreements wiped out." The railroads surely would not be helping the country by throwing themselves into receivers' hands.

Change in Engineering Emphasis

CERTAIN types of engineering problems have at times overshadowed the engineering field. The development of waterways was once, in this country at least, the leading civil-engineering problem. At another time the railroads absorbed engineering attention. Then came the steel bridge, the structural-steel skyscraper, water purification, sewage disposal and reinforced concrete.

The present is, in this respect, no different than the past, but the interesting feature now is that we have swung back to a type of problem that was dominant in the days of the country's meager physical development. We are again in an era of transportation dominance—railroad terminals, highways, port developments and city transit are clearly the leading engineering questions.

The highway problem repeats the railroad history of former times. The day of building new roads is nearly passed. We are in the second stage, strengthening the roads that they may bear the increased traffic, just as, after the first period of railroad building, there set in an era of roadbed and bridge reconstruction.

In terminal work and in city transit the problems are somewhat different. The developments of the past have led to serious congestion, and our efforts here relate to the curing of conditions which the work of former days has brought upon us. In accomplishing a certain result, that of making city life possible and attractive—through water and sewerage, good paving and electric light—we have created new situations that urgently press for solution.

The dominance of these transportation problems at the minute does not, of course, detract from the importance to the community of other lines of engineering. They do indicate, however, directions in which we may expect rapid development as well as fields that are particularly attractive for the employment of engineering initiative and ability.

A Tax on Construction

EVERY contractor and engineer knows how union working rules hinder construction progress and add to construction costs. Jurisdictional disputes and trade dictation are the bane of the builder's existence. It is rarely, though, that the extent of these union practices are set forth as completely or as clearly as has been done by Col. C. R. Gow in the paper which is abstracted on another page. It would take a decidedly partisan mind to find complete justification for the unions in the face of so detailed an indictment.

Doubtless the working rules have grown up as an honest effort to meet familiar abuses on the part of the

employer and to insure the greatest good to the greatest number of workmen, but they long ago overstepped the bounds of economic propriety and they now include many stipulations looking only toward immediate gain to certain individual workers. Many of them, such as the ban on paint sprayers and the insistence on hand-cutting of pipe, are of precisely the same order of intelligence as the early efforts of the hand worker to prevent the introduction of machinery. Others, such as the requirement that iron workers place reinforcement, in a different way perpetuate the same economic fallacy. The result is sabotage, of just as vicious a nature as though the worker deliberately soldiered or broke machinery in order to reduce production.

Individual resentment on the part of the employer is not going to do much toward remedying this evil, for to the unionist these rules are the very essence of his creed and any attack on them is to him an attack on the basic principles of unionism. Yet it is so obvious that they should be not allowed to persist in their present radical form that concerted effort on the part of engineers and contractors should be made to present to the union leaders the specific faults they evidence. Many of the employers of construction labor sympathize with the aims of union labor and appreciate the advantages it can bring to construction in general. Such men ought to be able to persuade the clearer thinkers in union circles of the evils, both specific and general, of such rules as Colonel Gow cites. Engineering societies have hitherto refrained from any excursions into the labor controversy. Is not the time ripe for the engineers to break a new path in their activities and to try with the aid of the now well established Associated General Contractors to bring about some amelioration of these rules, which are so great a tax on construction and which therefore, in the long run, penalize alike the contractor, the engineer, the workman, and the public?

Wildcatting in Irrigation

SO MUCH publicity has been given to a scheme for a state-wide development of water resources in California, called the Marshall plan, that anyone interested in irrigation is likely to have heard a great deal about it. Because of the methods used in securing widespread publicity for the scheme, *Engineering News-Record* feels warranted in devoting space (p. 994) to an outline of the plan and a résumé of views held by those who oppose its adoption.

California now has excellent irrigation laws. They have frequently been copied in forming new water codes for other western states. In addition to the numerous irrigation districts operating under these laws, there are many proposed or partially completed irrigation and reclamation organizations in various stages of advancement. Most of these are well-considered ventures which should be encouraged in financing and carrying out their plans. Other developments of the same sort should be proposed and carried out from time to time. There is yet much land in California capable of being irrigated from near-by sources. Development is delayed chiefly by the difficulty of getting the necessary capital.

The organization formed to conduct a campaign for the Marshall plan began by securing widespread publicity in country newspapers and holding mass meetings where the future of a great state-wide irrigation system could be pictured in glowing colors. These methods do not make a favorable impression in financial circles, and it is there that confidence must be established before any great undertaking can be launched. Unfortunately they do attract a popular following. Public sentiment is credulous. The lay mind is prone to accept any "engineer" as authority on any and all engineering matters. But so long as comparatively inexpensive irrigation works such as are necessary in developing near-by sources can be financed only gradually, there is little prospect for consummating a development that, at best, would require the outlay of hundreds of millions of dollars.

Fundamentally the idea of making further studies of unknown water resources is good. It is also very desirable that all irrigation interests should work in harmony and study the possibilities of more efficient use of the waters of the state. These features of the Marshall plan are commendable. Beyond that there seems to be little in its favor. The director of the United States Reclamation Service has twice declared that neither the Reclamation Service nor anyone connected with it has anything to do with the scheme; engineering organizations in California have condemned it, and the best irrigation engineers of that state, who are vigorously opposing it, are citing numerous instances where it has delayed much needed development work.

In so far as the organization campaigning for the Marshall plan is stirring up a popular sentiment in defiance of the opinion of the best authorities on irrigation development in California; in so far as this sentiment may retard irrigation developments and unduly inflate the value of arid land in anticipation of an irrigation development whose practicability has yet to be shown; just so far, *Engineering News-Record* believes, will this activity be harmful to California.

Recently, since vigorous opposition has arisen, the Marshall plan campaign has been carried into new fields and its literature has appeared in many eastern newspapers. Because the campaign is skillfully managed it will doubtless attract some capital to investment in California land and will continue to secure subscriptions for the expenses of the campaign. If it develops that the Marshall plan is wholly impracticable, eastern speculation in arid lands dependent upon it will probably not retard later irrigation development in California so much as would speculation in those lands with the limited capital available locally, but in the long run the good name of the state would suffer more from the eastern speculation.

There is a vast difference between an engineering report on the general features of a project, such as a board of experts could prepare with little delay, and a half million dollar investigation such as the Marshall plan campaign aims to secure, or even the $200,000 study authorized by the bill which has just passed the Legislature. These sums are so large and the studies involved in their expenditure so pretentious as to imply that the project is feasible and that the matter has reached a stage where alternate methods and programs should be compared. Obviously, this is not the case, but the publicity campaign having been successful enough to lead the Legislature to appropriate $200,000, it should be the duty of all engineers in the state to see that the funds, if authorized by the Governor, be used not to boost any chimerical scheme, such as that proposed by Mr. Marshall, but that a sane, impartial study of California's water resources be made.

Clam-Shell Dredges of Large Size on the Sacramento

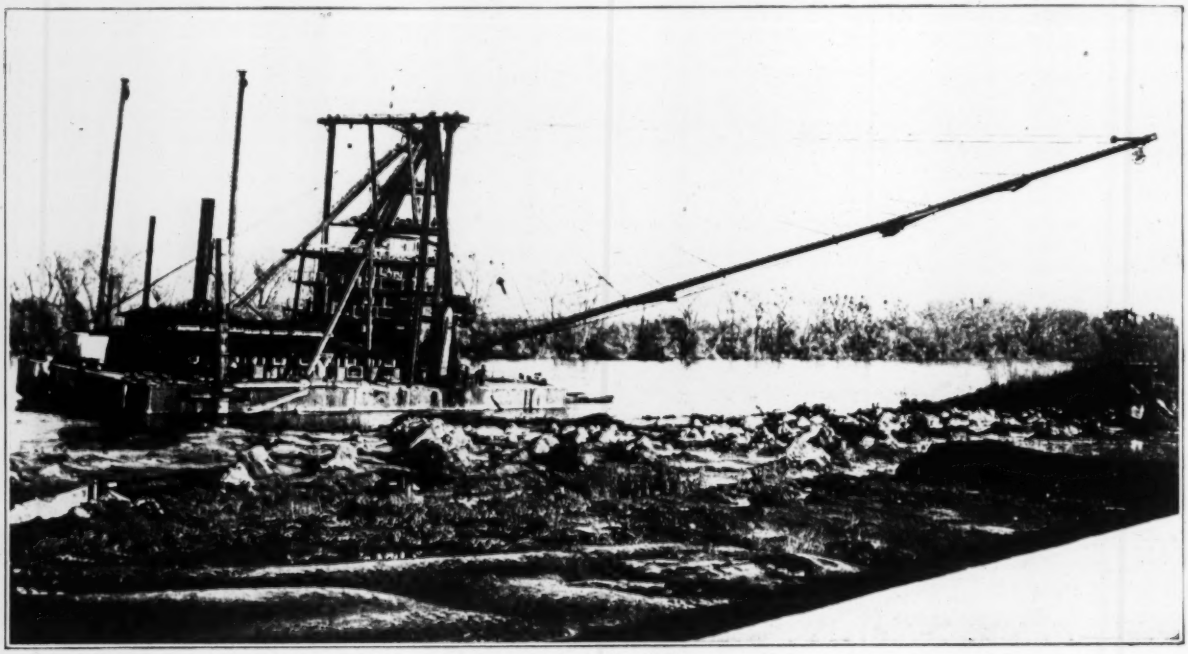
Use of 240-Ft. Boom Greatly Increases Range of Operations — Improvements Recently Made in Design of Hull and Rigging

NUMEROUS improvements in the design and construction of clam-shell dredges built in recent years for use in the Sacramento Valley in California, have materially extended the scope of canal and levee work that can be done with such equipment. Canals with a bottom width of 500 ft. have been constructed without rehandling any material. Modern dredges of this sort, with booms up to 240 ft. in length, operate buckets which carry as much as 8 cu.yd. of material. With only two cables through the sheaves at the end of the boom they perform the several operations of raising, lowering, opening and closing the bucket as well as swinging the boom. The boom itself is not raised during the dredging operations but merely swings from side to side. Counterbalanced sheaves are used in place of "sister-sheaves" which wore the cable rapidly, ballast tanks make it possible to swing the boom against high winds and by giving just enough forward overhang to the A-frame to offset the list of the hull, better control of the boom is secured. Descriptions of some of the earlier and smaller dredges of this type appear in *Engineering News*, Sept. 4, 1913, p. 457, and *The Engineering Record*, Feb. 20, 1915, p. 227.

There are certain limitations on this type of dredge. For example, it is impractical to deliver full loads to the right and left banks of the channel alternately, and the bucket ordinarily has to be dumped from the level at which its elevation was arrested (though of course the boom can be swung meantime). However, these points are not considered disadvantageous for most of the levee and canal work in the Sacramento Valley, and the simplicity of the rig required when these limitations are imposed makes it possible to use much longer booms than would otherwise be feasible.

The two lines which operate the bucket, known as the port and starboard lines respectively, run from their drums to sheaves on opposite sides of the A-frame near the bottom, thus having the advantage of leverage equal to nearly half the dredge width for swinging the boom. When material is being delivered to the port side of the dredge, the port line closes the bucket and, as the jaws meet, becomes a hoisting line, at the same time starting the boom swinging to port. When the bucket has reached the desired elevation, a decrease, though not a release, of the tension in the line arrests its vertical motion. Even a slight tension in the line, however, coupled with the list of the hull, is sufficient to keep the boom swinging to port, and this swing continues until arrested by tension in the starboard line. When the pull in the starboard line is increased sufficiently, together with a release of the port line, the jaws of the bucket are pulled apart and the load is dumped. Increasing still more the tension in the starboard line pulls the boom back toward its central position and there both lines are released to allow the bucket to drop again for its load. In well-regulated operation, the bucket is handled so that it rises diagonally, closely paralleling the water slope of the levee. In fact, a skillful lever man will smooth and compact the river slope to a very considerable extent by dragging over it the dripping, loaded bucket.

It is impracticable to stop a loaded bucket and hold it stationary, in fact, it can be done only by an experi-



THE "NEPTUNE," SHOWING 240-FOOT BOOM AND SUPERSTRUCTURE DESIGN

enced operator who can accurately control and balance the tensions on the two lines. When the dredge is to be changed over from port to starboard delivery, the bucket connections of the port and starboard lines are interchanged—an operation which requires two or three hours on the larger dredges.

With this cable arrangement a considerable element of safety for the boom is introduced by the fact that if the cable is jerked suddenly for any reason, the bucket will simply be raised and the shock will not be sustained by the boom. In order that this safeguard may be operative, however, it is necessary that there be a considerable space between the bucket and the end of the boom. Hence, as a matter of caution, the bucket is never drawn up close to the boom end.

THIS BUCKET HAS A CAPACITY OF 6 CU.YD. AND OFTEN HANDLES 8 CU.YD.
(Note arrangement of control lines, also leverage for closing jaws)

The strains that come on the boom call for an elasticity which is believed to preclude the use of any material other than wood. The longer booms are made up of 24 x 28-in. timbers in 110-ft. sections spliced with bolted, scarfed joints 27 ft. long. The principal member in the system of trussing used to strengthen the boom against lateral bending is a cable that passes through saddles on the ends of cross-arm struts. By being free to slip on these struts the bracing system is given the desired flexibility. Before the bucket is attached, the guys which support the boom in a vertical plane are tightened until the end of the boom is raised about 2 ft. This compensates for the bending of the boom caused by the weight of the bucket.

Determination of the proper amount of forward overhang of the A-frame is an important feature in the design of these dredges. Factors that enter into this are boom length, list of the hull for various loads and positions of the boom, and the center of gravity of the dredge. The overhang of the A-frame results in a tendency to raise the end of the boom as it is swung. (To make this obvious imagine an excessive A-frame overhang.) The list of the hull that follows the swing of the boom, on the other hand, tends to lower the boom end. These two opposite tendencies are balanced to secure the desired results. That is, by plotting the several factors that are involved in the case of each particular dredge, it is possible to determine an amount of overhang such that as the loaded boom swings from center to side, the boom end moves in an almost horizontal plane. In a well-designed dredge of this type there is very little "flyback" of the bucket on emptying. The effect of the overhang is allowed to dominate the opposite effects of list just enough so that when port and starboard lines are both slack the boom tends to swing of its own accord to the central position. On the larger dredges the overhang is between 4 and 6 ft. The boom is made to swing through a central angle of 130 to 180 deg., according to the work for which the dredge is designed.

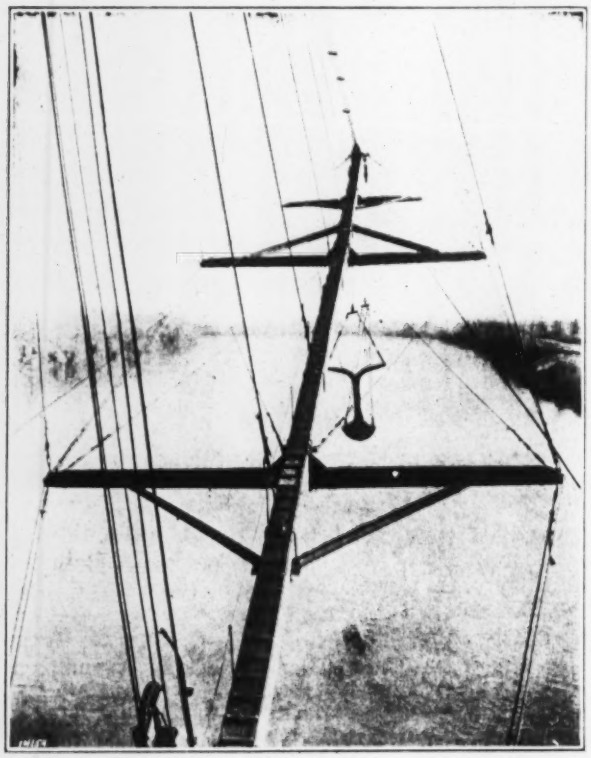
With a two-cable control, it was very difficult, if not impossible, to work the earlier types of dredges in the high winds which frequently prevail in the lower Sacramento Valley. A recent improvement, however, is the provision of water ballast tanks along both sides of the hull so that the hull can be listed either to port or to starboard so as to result, in combination with the overhang of the A-frame, in offsetting the effect of a side wind in retarding the swing of the boom.

Because of the wide range in position of the port and starboard cables for different positions of the boom, earlier dredges used what were called "sister-sheaves" for guiding them. A pair of these sheaves was attached to each side of the A-frame near its base and was to provide sheave action for the cable as much of the time as possible. In certain positions on each lift, however, the cable cut across the flange of one of the sheaves and caused very rapid wear. More recently, a single-counterbalanced sheave has been developed which is able to adjust itself to any position without causing more than one bend in the cable, thus very greatly increasing its life. In order to avoid the breakage and the consequent delay which occurs from worn cables, some dredge operators have formed the practice of cutting off a few feet of the cable at the outer or bucket end every few days, thus changing the point of maximum wear from time to time.

The following features of the dredge "Neptune" give an example of the latest practice in such equipment.

The hull of the "Neptune" is 70 x 150 ft. in plan and 13 ft. deep. Both steel and wood were used in the construction. It has three fore-and-aft and three

athwart-ships trusses, all of steel. In the longitudinal trusses the chords are made of 12-in. channels with 10-in. H-sections for struts and diagonals. In the cross trusses the chords are made of 12-in. channels with struts and diagonals of 6-in. H-sections. The side and bottom frames are made of 12-in. channels on 36-in. centers. The sides are made of ⅜-in. plates. By making the bottom of wood, a cushion is provided in case the dredge strikes bottom. The A-frame and back-legs are of steel and are connected to the fore-and-aft trusses with gusset plates, thus greatly increasing the rigidity



LOOKING OUT THE BOOM FROM THE PILOT HOUSE

of the hull. The deck is made of wood and is cambered, both fore-and-aft and athwart-ships.

The top of the A-frame is 82 ft. above the deck and to its apex is attached the topping lift made up of 10 parts of 1⅜ galvanized-steel cable. When swinging a full bucket the strain on this lift is about 110 tons. The bucket itself weighs 15 tons and carries a load of about 12 tons. The weight of the boom complete is about 12 tons.

When the boom has swung its maximum distance to one side with a full bucket, the load on the 3½-in. hog rods, holding the A-frame, is from 145 to 160 tons with a corresponding compression load on the A-frame legs. The necessity for rigid construction is apparent from the fact that the bucket is swung from 30 to 35 times per hour and the dredges are worked 24 hours per day. The step plate at the lower end of the boom is designed to take a compression of 120 tons and a side pressure of a like amount. It has a steel center pin 10½ in. in diameter and a base plate 5 ft. square. The gin sheaves on the end of the boom are 6 ft. in diameter, grooved for 1½-in. cable and weigh with shackles about 4 tons.

The spuds are single pieces of timber, 36 x 36 in. in section and 70 ft. long, fitted with cast-steel points. In addition to the usual operation of the dredge by means of the spuds, the "Neptune" has a steam-operated fleeting gear with which the dredge can be moved forward any distance up to 9 ft. between swings of the boom. This is very useful in giving a smooth finish when "topping off" a levee.

The power equipment includes a 250-hp. oil-burning boiler which supplies steam for engines on the drums that operate the cables. The oil consumption is about 45,000 gal. per month. The port and starboard cables are 1½ in. in diameter operated on a 4-ft. drum with frictions 9 ft. in diameter. Controls for all operating equipment are handled by the lever-man in the pilot house which is about 100 ft. away from the engines and 65 ft. above water level. There are also spud engines capable of raising all three spuds simultaneously. The displacement of the "Neptune" is 1,300 tons. Quarters are provided on board for 15 men, from which are made up three crews working 8-hour shifts. The superstructure is sheathed with asbestos-protected steel which serves the dual purpose of decreasing the fire risk and keeping down the interior temperature in the summer.

Levee Dimensions

With a machine of this size, the very large levees required in the Sacramento Valley are easily built. Typical dimensions for the larger levees in that district are as follows: Height about 25 ft., 1 to 3 slope and a 30-ft. berm on the river side and a 1 to 2 slope on the land side. During low water periods, to reach the rear edge of the levee crown, material must be placed about 175 ft. from the edge of the dredge hull.

For the most part dredges of this type are owned by dredging companies which lease them to the state, reclamation districts, etc., on the basis of a stated rate per working hour, that is, delays due to broken machinery, foggy weather, etc., are not paid for. The rate varies with the length of the boom, the size of the bucket and the reputation of the dredge as a producer, but depends chiefly on the length of the boom.

As an example of the cost of operating equipment of this sort, it may be stated that contracts with the United States Government in July, 1920, were as follows: For a dredge with 175-ft. boom, $9.17 per hour; for a dredge with 200-ft. boom, $11.02 per hour. The rate on the Neptune with its 240-ft. boom is $13.08 per hour. While the long booms ordinarily have a slower swing, they usually carry larger buckets than do smaller dredges and hence net more yardage. The yardage handled varies, according to material and dredge, from 50,000 to 90,000 cu.yd. per month. On 8.26 mi. of levee built for the Natomas Consolidated in 1914, 592,000 cu.yd. was moved at a cost of 9.3c. per yard. This was in hard clay where considerable blasting was necessary. The present rates are stated to be about 35 per cent more than 1914 prices. The dredges which did most of this 1914 work had 168- to 200-ft. booms with 4½- to 5½-cu.yd. buckets.

Experiments are now under way with a so-called "dredge-meter," an instrument for recording the side and forward list of the hull. The function of this device, which is not yet fully developed, is to record the yardage actually handled by the dredge. In theory it is based on the fact that the forward list of the dredge is a function of the weight of material handled and

hence of the yardage. The number of swings to the side records the number of loads handled.

In the preparation of the foregoing data acknowledgment is made of material supplied by Fred H. Tibbetts, consulting engineer of San Francisco, and F. F. Cooper, Olympian Dredging Co., San Francisco.

Concrete Road Building Demands Best Contracting Skill

CONCRETE road building can best be carried forward by attracting to it the responsible contractor, by standardizing in so far as is possible kinds of construction and methods of operation, by establishing definite programs of development that may spread over a number of years, and by the co-operation of engineers and contractors to secure the least expensive construction consonant with good workmanship. These opinions were voiced by W. A. Rogers, president of the Rogers Construction Co. of Chicago, in a recent meeting of the executive board of the Associated General Contractors of America held in Washington.

It is just as necessary, said Mr. Rogers, that reputable and experienced contractors enter the concrete-road construction field as it was for them to assist materially in the development of the railways of the country. The construction of concrete highways, he said, was of such a highly technical character that competent organizations with expensive plants, compared with the volume of the work, should have a major part in it.

"In the past," said Mr. Rogers, "highway work, because of the conditions surrounding it, has not been considered desirable by responsible contractors generally. In fact, it has proved to be one of the most hazardous forms of contracting, because of conditions surrounding this work over which the contractor has no control. It is absolutely dependent for its economical handling on a uniform regular supply of materials delivered over the railroads and in the past this has been difficult, if not impossible, to obtain."

As to standardization, Mr. Rogers asserted that there were practically as many types of highway, varieties of specifications as to materials and workmanship, methods of payment and types of organization for handling the owner's side of the work, as there are states in the United States. He said that the difficulties of one contractor, becoming accustomed to the method of operation and construction demanded by one state, and then moving to another to operate, were obvious.

The need to stabilize construction so that definite programs covering a period of years might be adopted was emphasized by Mr. Rogers. He asserted that the investment in plant and organization for highway work was greater than that of almost any other contract work in proportion to the volume done. Before making such large outlays he said that contractors should have the assurance that expensive plants would be more or less continuously occupied.

Mr. Rogers asserted that there was a large opportunity for the Associated General Contractors to co-operate with engineers and owners in securing the best concrete highways; and that elimination of non-essentials in specifications was not only desirable but necessary.

Mr. Rogers said that with standardization, stabilization and co-operation in effect, the greatest return with the least expenditure of money would be secured.

A Short Method for Swing Bridge Calculations

Statically Indeterminate Stresses Found From Determinate Cases of Loading by Multiplying by Ratio of Influence

By Charles A. Ellis
Professor of Structural Engineering, University of Illinois, Urbana, Ill.

A SHORT method for obtaining the stresses in the members of a continuous truss was discovered by the writer in 1914 and since that time has been presented to graduate students, and to those undergraduate students at the University of Illinois who do major work in structural engineering. The writer's belief that the method is new has been strengthened by recent conversations and correspondence with a number of eminent bridge engineers in America. An explanation of this method will be made in connection with the swing bridge of two equal spans as illustrated in Fig. 2. The live load on each rail is a Coopers E 40 as shown in Fig. 1.

The stresses for five cases or conditions of loading are usually considered:

Case I—Dead load, bridge open or wholly supported at the center.

Case II—Dead load, bridge closed, both ends raised until a definite reaction at each end is attained.

Case III—Live load on one arm only, acting as a simple span.

Case IV—Live load on one arm only, continuous girder action.

Case V—Live load on both arms, continuous girder action.

Positive Shear in End Panel

Case III—The influence line *abc* for shear in the panel is shown in Fig. 3, from which the criterion for maximum shear may be developed. This criterion is well known. If P_1 is the load in the panel 0-1, and P is the total load on the span 0-6, then we know that $P_1 \leq P/6$. When the train is moving to the left, wheel 4 passing L_1 satisfies this criterion, and the maximum shear in the panel is 162,000 lb. The area of *abc* is 62.5, and the equivalent uniform load is 162,000/62.5 = 2,590 lb. per lin.ft.

Case IV—With left arm loaded, the influence line *defghij* for shear in the panel is shown in Fig. 4. The ordinates are determined by assuming that the truss functions as a beam of uniform section continuous over three supports. The criterion for maximum shear may be stated as follows: If P_1 is the load in panel 0-1, P_2 the load in panel 1-2, etc., then $793\ P_1 \quad 200\ P_2 + 187\ P_3 + 165\ P_4 + 138\ P_5 + 103\ P_6$. Wheel 4 passing L_1 satisfies this criterion also, and the maximum shear determined by taking the sum of the products of each floor-beam load and its corresponding ordinate in the influence line diagram, is 139,700 lb.

If the influence line *defghij* were straight from *e* to *j* the criterion for maximum shear in the panel would be the same as for Case III. The difference between the broken line *efghij* and a straight line from *e* to *j* is so slight in this or any similar truss that the criterion for maximum shear in the panel will, in general, place the train in the same position or approximately the same position as will the criterion for Case III. A very close approximation to the shear of 139,700 lb. can be made

very quickly by assuming the same equivalent uniform load in both cases; or in other words, by assuming that the shears in the panel for the two cases are directly proportional to the areas of the respective influence-line diagrams. These areas are proportional to the sums of their respective ordinates, thus:

area *abc*: area *defghij* : : 2.5 : 2.14

Hence the shear in the panel for Case IV equals 162,000 × 2.14 2.5 or 138,300 lb. This is a reasonably close approximation to the actual shear of 139,700 lb.

It is now obvious that the stresses in $L_0 U_1$ and $L_0 L_1$

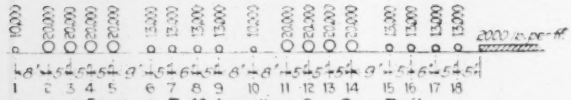


FIG. 1

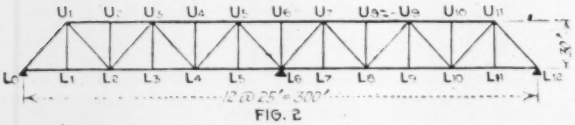


FIG. 2

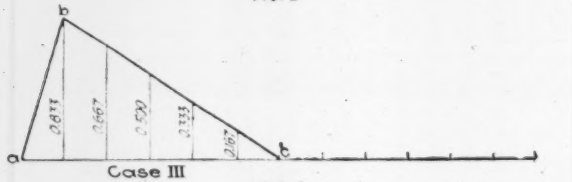


FIG. 3

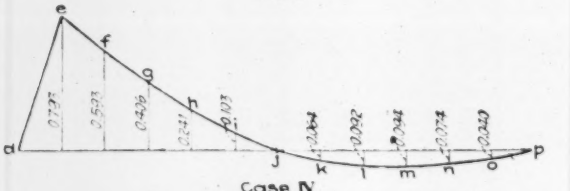


FIG. 4

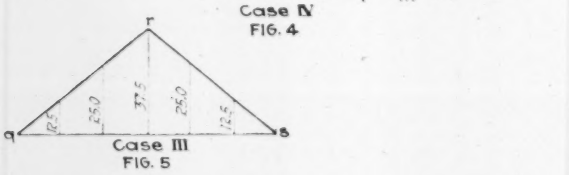


FIG. 5

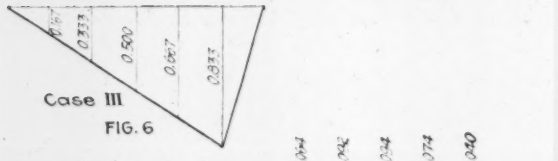


FIG. 6

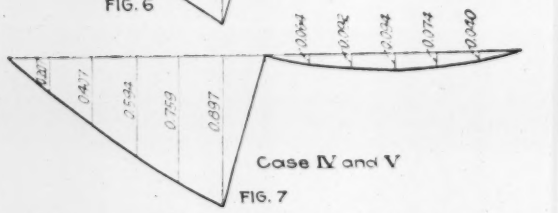


FIG. 7

APPROXIMATE INFLUENCE-LINE METHOD FOR SWING BRIDGES

may be quickly determined for Case IV with sufficient accuracy by multiplying the stresses for Case III by the ratio 2.14/2.50. This ratio for panel 0-1 remains the same for any bridge having six equal panels in each arm irrespective of the length of the panel.

Case IV—With right arm loaded, the influence line *jklmnop* is as shown in Fig. 4. The criterion for maximum negative shear in panel 0-1 is $64 P_7 + 28 P_8 - 2 P_9 \leqslant 20 P_{10} + 34 P_{11} + 40 P_{12}$.

There are two positions of the train which satisfy this criterion when the train is moving toward the left, namely wheel 11 at L_2 and wheel 8 at L_1. The maximum shear, occurring when the train is in the latter position, is — 22,770 lb., as found by taking the sum of the products of each floor-beam load and its corresponding ordinate. This value may be approximated very quickly as follows: Since the influence line has its longest ordinate at the center of the arm, it will be compared with the influence line *qrs* (Fig. 5). The latter is the influence line for moment at U_2 for Case III, and the sum of the ordinates is 112.5. The stress in $L_0 L_1$ for Case III is 235,200 lb., hence the moment at U_2 is 235,200 × 30. The sum of the ordinates in the diagram *jklmnop*, Fig. 4, is —0.364. Hence the approximate maximum end shear in panel 0-1 is $235{,}200 \times 30 \times \frac{-0.364}{112.5} =$ —22,830 lb., which compares favorably with the actual shear of —22,770 lb.

Negative Shear in Panel 5–6

The influence lines are shown in Figs. 6 and 7.

Case III—The maximum negative shear in panel 5–6, when the train is moving toward the right, occurs when wheel 4 is at L_5 and equals —162,000 lb. The maximum negative shear when the train is moving toward the left, occurs when wheel 16 is at L_5 and equals —151,700 lb.

Case IV—The criterion for maximum negative shear in panel 5–6 is: $897 P_4 - 138 P_5 + 145 P_7 + 187 P_8 + 200 P_9 + 207 P_{10}$. Wheel 4 at L_5 satisfies this criterion and gives the maximum shear as —184,700 lb. By the approximate method the shear is —162,000 × 2.864/2.5, or —185,600 lb.

Case V—When both arms are loaded the maximum negative shear occurs when the train is moving to the left with wheel 17 at L_5. The right arm supports a uniform train load of 2,000 lb. per lin.ft. The maximum shear, determined by taking the sum of the products of each floor beam load and its corresponding ordinate in the influence line diagram, is —191,700 lb.

By the approximate method the shear caused by the load on the left arm is —151,700 × 2.864/2.5, or —173,800 lb.; the shear caused by the uniform load of 2,000 lb. per lin.ft. on the right arm is —0.364 × 50,000, or —18,200 lb.; and the total shear is —173,800 —18,200 = —192,000 lb.

Reversals of Stress

The method gives equally satisfactory results when applied to web members. It should be noted, however, that the influence line in passing from a positive to a negative area does not cross the base line at the same point in a panel for Case IV as for Case III. For this reason the approximation will be somewhat closer if the ratio of the areas is taken instead of the ratio of the sums of the ordinates.

Whenever each arm has six or more equal panels a reversal of stress for Case IV, but not for Case III, occurs in one or more chord members of the loaded arm adjacent the center support. The member $L_4 L_5$ is an example. The stresses for Case IV cannot be approximated as heretofore because of the dissimilarity of the influence line diagrams. In such instances the equiva-

lent uniform load may be approximated by the use of diagrams; see "Modern Framed Structures," 9th ed., Part I, p. 251, or D. B. Steinman's article in *Engineering News*, Vol. 73, page 781.

Application to Arches.—This proportional method is applicable to the solution of stresses in the members of a two-hinged arch. A third hinge is assumed at the center. The influence diagrams are then drawn for the two-hinged and the three-hinged arches. After the criterions have been developed and the stresses determined for the three-hinged arch by the use of a moment table, the stresses for the two-hinged arch may be quickly approximated by means of the ratio of the respective areas of the two diagrams.

Centrifugal Pumps for High Head at Shenandoah, Pa.

By Farley Gannett and Jacob L. Crane, Jr.
Of Gannett, Seelye & Fleming, Inc., Engineers, Harrisburg, Pa.

THE municipal water-works at Shenandoah, Pa., recently completed an installation of two electric-motor-driven, 2 m.g.d. centrifugal pumps, which work against a total head of 1,000 ft. and have an over-all efficiency of 62 per cent. The pumps, which are only three-stage, together with certain details of installation, are of unusual interest. Incidentally, but by no means least important, pumping costs are reduced by over $12,000 per year, a reduction of 35 per cent.

Shenandoah is a community of about 32,000 people, situated in the heart of the lower anthracite coal region of Pennsylvania. The valley in which Shenandoah is located is so honeycombed by coal operations that it is impossible to secure water either from the surface or from under ground. It therefore became necessary to secure water in the adjoining valley, separated from Shenandoah by Locust Mountain, about 800 ft. high. The water-works plant uses the surface flow from several small mountain streams, impounded in a small reservoir, the water formerly being forced by steam pumps over Locust Mountain to the distribution reservoir and thence to the city.

These steam pumps, as well as the boilers and pumping station, now twenty years old, were at the end of their useful life. Still more critical, the advancing costs of coal, and of the two-mile haul from railroad to pumping station, and of operators' wages, had so increased the cost of steam pumping as to cause a serious situation.

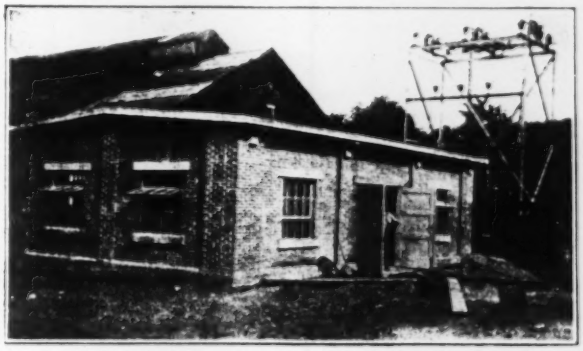
The high-voltage transmission line of the Harwood Electric Co. was built near by after the steam pumps were installed; the electric rates, which are not expected to advance, show a large saving over steam power; the electric-driven centrifugal pumps cost less than new steam pumps, require less space, are more easily and satisfactorily operated and make it possible to take power from the electric lines to the greatest advantage. It was therefore decided to put in electric-motor-driven centrifugal pumps.

The cost of the two pumps was $13,380; the building, $5,000; piping, $5,400; electrical equipment (transformers, substation, switchboard, instruments, etc.), $12,155. The total cost was about $40,000, including the engineering.

The pumps were built by the American Well Works and are three-stage only, lifting 333 ft. per stage—a most unusual type of pump. The shells are of cast steel, the wearing rings of bronze, shaft sleeves of bronze, shafts of forged steel and the impellers and diffusion vanes of "U. S. Government Bronze." The 500-hp. motors are directly connected to the pumps and have a speed of 1,750 revolutions per minute.

Against a head of 1,000 ft. an efficiency of 62 per cent is being obtained. It is expected to clean the force main in 1921, which will reduce the head to below 900 feet.

The discharge is into a 12-in. steel force main 12,000 ft. long and twenty-six years old. The danger of blowing out this line when the pumps close down suddenly and the water slams against the check valves at the



NEW PUMPING STATION FOR SHENANDOAH
Houses two motor-driven, 2-m.g.d., three-stage centrifugal pumps working under head of 1,000 feet

pumps, creating a water hammer that might be disastrous, in view of the length of line and high head, seemed so great that special provision was made to prevent it. The force main is divided into four sections by three check valves and just above each check valve, and also at the pumps, an automatic blowoff valve is placed. This serves to divide up the length of the line and also the pressure, and allows the pressure to be relieved at each of the division points. This scheme was designed to relieve the water hammer and has done so very successfully.

The old pump broke down the day after the new centrifugal pumps were completely installed, and these pumps have supplied the borough with water continuously, without any shutdown for repair or adjustments, so often necessary in new installations.

This installation we believe to be the largest of its kind in the United States, the two three-stage centrifugal pumps having a capacity close to 4 m.g.d., pumping against a head of 1,000 feet.

Tunnel Under Thames Proposed

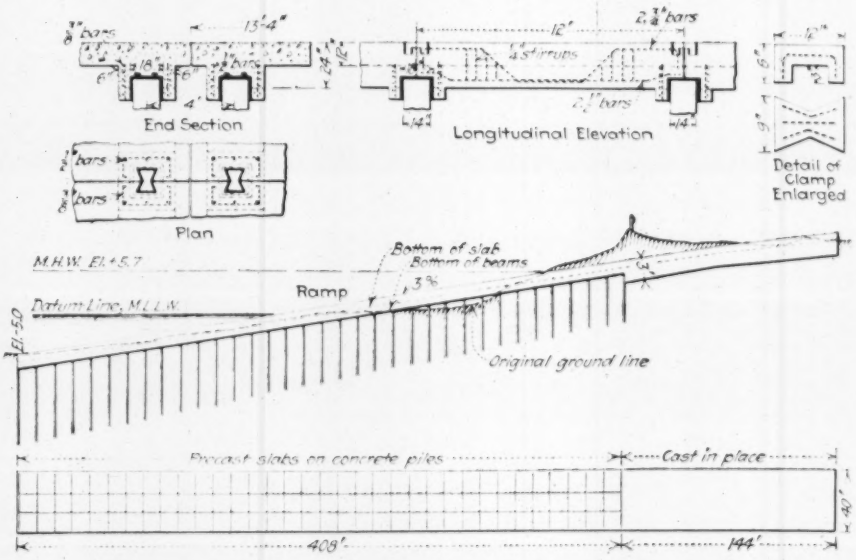
Parliamentary sanction is sought by a private company for the construction of a tunnel at the mouth of the Thames to link up the north and south banks. At present a substantial amount of shipping is berthed in Tilbury Docks on the north side with goods consigned to Gravesend which is on the south. Under the conditions obtaining now these goods have to travel to Gravesend via London, a distance of nearly 60 miles, though Tilbury and Gravesend are almost within shouting distance. The tunnel has extensive support throughout the country and a deputation is to await on the Ministry of Transport urging an early commencement of the task.

Precast Slabs Set on Submerged Concrete Piles

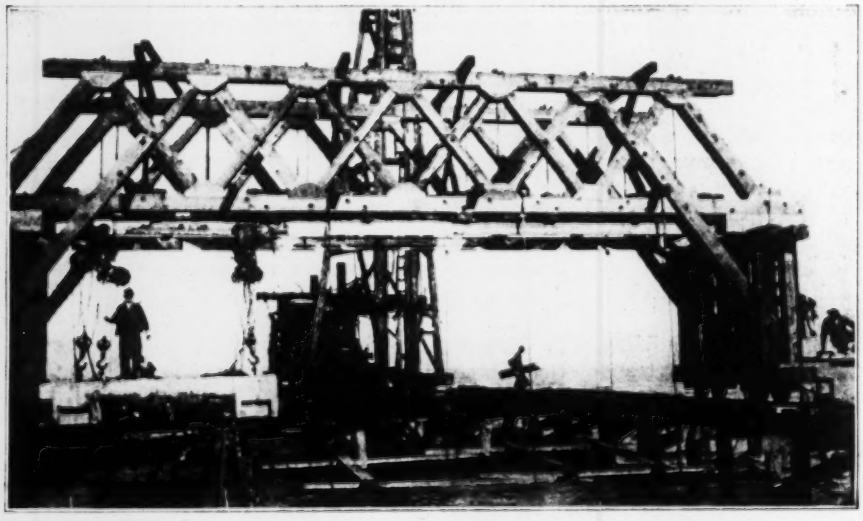
Unit Construction Plan Made Possible by Precise Methods in Building Ramp for Seaplane Landing in San Francisco

A RAMP on which to bring floating seaplanes ashore has recently been completed at the air coast defense station in the Presidio on San Francisco Bay. The ramp surface is made up of precast concrete slabs which were poured in a casting yard and placed by means of a gantry crane on accurately located concrete piles. The open caisson method of construction was not feasible, it was thought, because the porous bottom would have made it difficult if not impossible to unwater a caisson. Even on the lower end of the work where the slabs had to be set in place with the aid of divers the alignment of each slab was checked to the nearest hundredth of a foot by means of a bolt-and-thread device for adjusting the thickness of grout on top of the supporting piles. One hundred and two slabs, each weighing about 18 tons, were placed in the ramp which, after being completed, is reported to be in such good alignment that the joints are not apparent. The width is 40 ft. and the full length, on a 3 per cent grade, is 550 ft. The site chosen for the ramp was at a spot where the natural slope of the shore approximated the 3 per cent grade desired. Thus not much excavation was required. Such excavation as was necessary below water level was done with a floating derrick and that above the water line by means of scrapers and teams. A pile falsework was then built over the 408-ft. section of the ramp on which the precast slabs were to be used. This falsework carried rails for the ramp gantry crane, which had a span of 50 ft., the pile supports for the rails being outside the ramp on both sides.

A piledriver, working on this falsework, then drove the concrete piles. These were 14 in. square and ranged in length up to 25 ft.; four piles were placed for each slab. The piles were located in the exact position desired with a transit. Steel extension leads were used on the driver, arranged to slide down below the ends of the permanent leads as much as might be necessary to rest on the bottom at the point where each pile was driven. A No. 1 Vulcan hammer was used and a 2-in. jet was put down with all piles. The excavation was calculated so the piles would project about 2 ft. above the bottom when driven to exact grade. The elevation of the tops of the piles was an important matter. In order to check this closely a hardwood follower was used, well banded at the ends to prevent brooming, and the shore side of this follower was marked with graduations similar to those on a level rod and reading to hundredths of a foot. A level instrument was kept focused on these graduations as the pile went down, and the steam engineer on the driver took signals direct from the levelman.



DETAILS OF REINFORCED-CONCRETE SLABS AND PLAN AND ELEVATION OF SEAPLANE RAMP

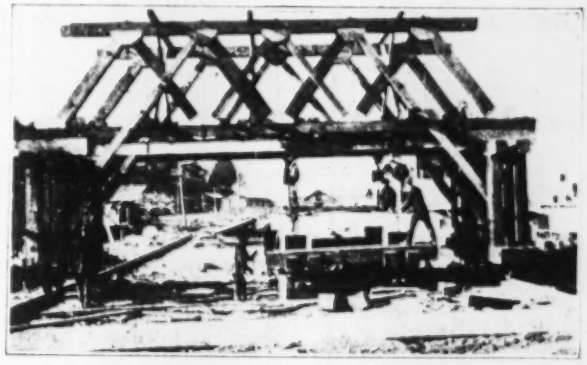


RAMP GANTRY WITH SLAB SUSPENDED OVER DELIVERY TRACK

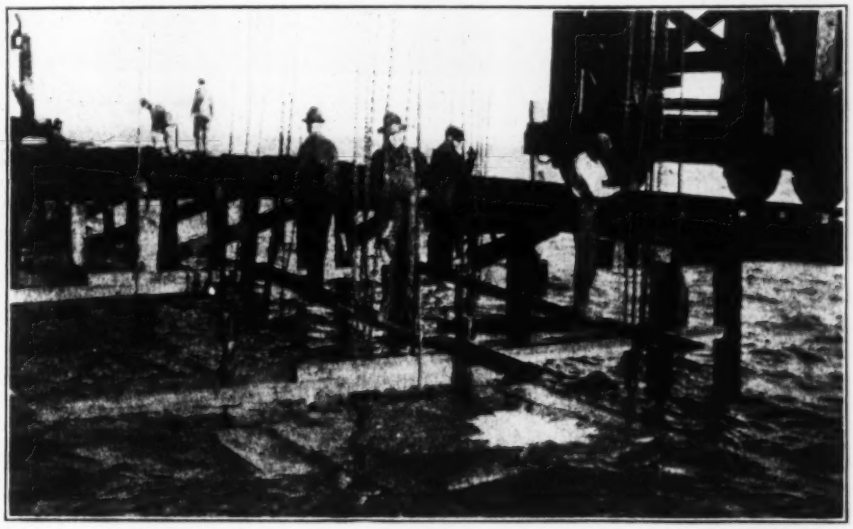
The casting yard was laid out at right angles to the center line of the ramp at its shore end. The forms for the slabs, which were about 12 x 13 ft. in plan, were laid out on the ground, reinforcing was placed in them and concrete was poured directly into the forms from hand buggies wheeled on planks laid out on top of the forms. Concrete was poured at the rate of about 80 cu.yd. per day. The slabs were cast three tiers high, form lumber being used to separate successive tiers. Loops of reinforcing steel

were placed in each of the four corners of the slabs to afford convenient means for lifting them when they were ready to be placed.

A 40-ft. wooden gantry crane spanned the casting yard and by means of four differential chain blocks, operated by hand, raised the slabs from the forms as they were needed on the work. This gantry delivered the slabs to a car of 10-ft. gage, operating on a track under the gantry. A turntable was located on this track at the head of the ramp and here the car with its slab was turned through a right angle so it could run down a track laid on the pile falsework and deliver the slab to chain-blocks on the ramp gantry. The chain-blocks on both gantries were suspended from carriers running the full gantry span on I-beams. Both gantries and the car operating between them were moved by means of cables running to a steam winch. There were also hand winches on the ramp gantry by means of which the four carriers and their chain-blocks could be moved as a unit in either direction across the ramp.



GANTRY OVER CASTING YARD



LOWERING SLAB TO SUBMERGED PILE SUPPORTS

The slabs are 12 in. thick and have two longitudinal beams with an overall depth of 24 in. Rectangular recesses were left in the ends of each beam for the piles, as shown in the accompanying drawing. Before pouring the slabs eight 1-in. bolts, each carrying two nuts, were placed in the bottom of the forms. Two bolts were put in each corner, with the heads projecting downward into the recess cast to receive the pile heads. When the concrete had hardened around the nuts the bolts could be turned in them and would thus be extended downward. With this arrangement, after a slab had been placed and until the grout in the joints had set, the slab was supported on the bolt heads. That is, the bolt heads rested directly on the tops of the piles. As the slabs were brought out on the ramp ready for placing two rod readings were taken on each pile at the exact spot where the bolt heads would rest. The difference between these readings and the desired level of the finished ramp surface at this point determined just how much the bolt projection should be and this was adjusted accordingly before lowering the slab into place.

Just before the slabs were lowered a bag or cushion of grout was fastened in the top of each of the recesses into which the pile heads were to fit. These bags were about 18 in. square and 1½ in. thick. The weight of the slab was so great that the bolt heads crushed through the bags to direct contact with the pile tops and the grout was forced into the space around the top and sides of the pile. Where additional grout was required to completely fill the joint this was supplied by the ordinary pressure grouting equipment. Keyways were left in the tops of the slabs and reinforced-concrete keys or clamps were fitted into these after the slabs had been placed. The keys were also grouted.

The 144 ft. at the upper end of the ramp located above high water line was poured in place as monolithic paving. In preparation for this paving the surface of the ground was merely worked down to grade. A beam or inverted curb, 3 ft. deep, was poured at either edge. Except for the inverted curbs the thickness in the paved section is 12 in., the same as in the precast section.

Information from which the foregoing was compiled was supplied by the Healy-Tibbitts Construction Co. of San Francisco, contractors on the work.

Wood and Steel Ties in England

High cost of wood ties in England is directing the attention of some of the railways to substitutes for wood as creosoted ties of Baltic fir which cost $1 to $1.25 before the war now cost $5 (at the old rate of exchange). A steel tie now being tried on the Northeastern Ry. is designed with the idea of employing standard rolled shapes and thus reducing the cost. It consists of a rolled channel 9 x 3 in., 8 ft. long, having near each end a pressed steel saddle or rail seat of inverted channel section, the sides of the saddle fitting inside the tie and being riveted to it. These saddles are shaped to give the rails the standard cant or inward inclination of 1 in 20. Flange rails of 100-lb. per yard are secured to each saddle by two bolted clips. The weight of the tie, apparently exclusive of the saddles, is 197 lb. This tie was designed and patented by C. F. Bengough, chief engineer of the Northeastern Ry.

Sewage Treatment Plant for Calumet Region of Chicago Sanitary District

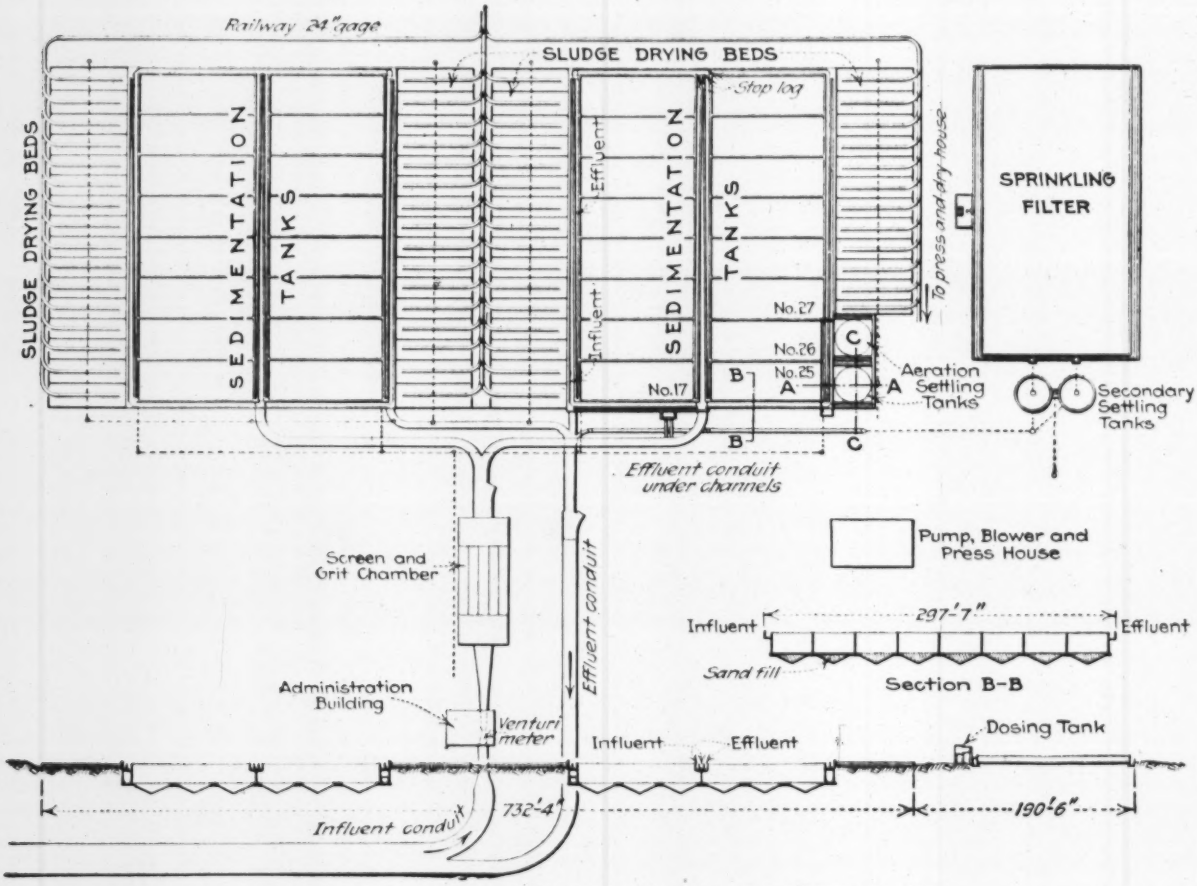
Imhoff Tanks Are Convertible Into Activated Sludge Tanks—Experimental Sludge Units and a Sprinkling Filter Are Provided

By Langdon Pearse
Sanitary Engineer, Sanitary District of Chicago

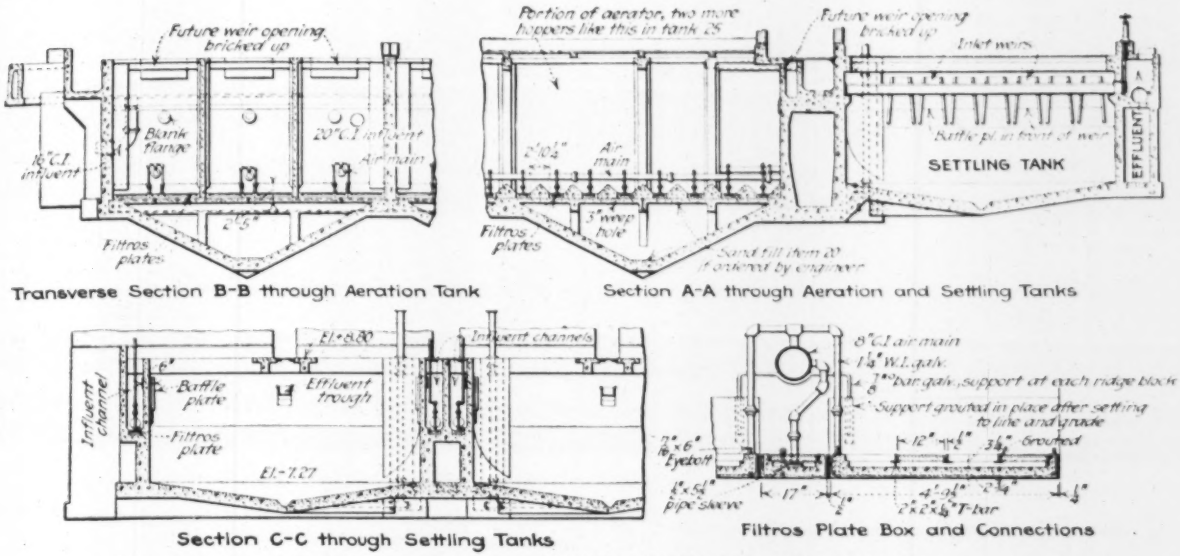
IN CONNECTION with the intercepting sewer system being built in the Calumet region. The Sanitary District of Chicago now has under construction a sewage treatment plant to serve 150,000 people and eventually an area of 18,000 acres. Its purpose is to remove the settling solids from the sewage before discharge into the Calumet Sag Channel. The plant includes Imhoff tanks, designed to permit ready conversion into aeration tanks; sludge drying beds; two activated-sludge units, one of which is to be tried on settled sewage, and one sprinkling filter unit with dosing tanks and secondary settling basins. Provision is to be made in the plant for dewatering and drying the activated sludge. The plant is fed by the Calumet sewage pumping station, the treated sewage returning to the station to enter the outfall. The effluent from the settling tanks will be pumped to the sprinkling filter.

The population tributary in 1922, when the plant will be completed, is estimated at 152,000, producing an average sewage flow of about 57 sec.-ft. The minimum flow has been taken as 70 per cent of the average. When the flow in the main interceptor, which picks up the drainage of 12,000 acres, is increased by storms, to a point where the hydraulic grade will not permit a return of the effluent to the outfall, the treatment plant will be shut down or the sewage discharged direct into the Calumet River through the emegency outlet. Owing to the presence of considerable ground water a somewhat weak sewage is expected, largely of domestic origin.

The sewage treatment plant is located on a 106-acre site a half mile east of the Calumet sewage pumping station. In between lie railroad yards of the Illinois Central and the Chicago & Western Indiana, with 53 tracks. The sewage will be pumped to the plant by the dry-flow pumps in the station, the station being equipped with sluice gates in the dryweather discharge basin for this purpose (see *Engineering News-Record*, Nov. 4, 1920, p. 872). The effluent from the treatment plant



GENERAL PLAN OF NEW CALUMET SEWAGE TREATMENT PLANT



DETAILS OF THE SETTLING AND OF THE AERATION TANKS

will be handled through the discharge basin of the pumping station for passage to the outfall to the controlling works of the Calumet Sag Channel, or to the emergency storm outlet to the Calumet River.

The pumping station will be connected to the treatment works by a novel three-barreled semi-elliptical conduit built in tunnel under the railroad yards (see *Engineering News-Record*, March 24, p. 500). The raw sewage will be carried in a 5½-ft. or a 7½-ft. barrel or both, according to the flow, to maintain sufficient velocity. The capacity of the two influent or the one effluent barrel is 200 sec.-ft. (estimated for 1950 to 1960). In addition to the sewage conduits, a 6-in. city water pipe has been laid across the railroad yards and an electrical conduit for the power and lighting cables.

Sewage entering the plant first passes through a 72 x 36-in. Venturi meter and then an inclined rack-bar screen with openings 1 in. in the clear. An 8½ x 5-ft. conduit delivers the sewage to a junction chamber, feeding the two double batteries of tanks by conduits each 6½ ft. x 3¾ ft. There are 32 tanks, arranged in four parallel batteries of eight each, planned to handle the sewage flow till 1932. Thirty are Imhoff tanks, the other two being converted into aeration tanks. Stoplogs in the distributing channels will control the operation of the tanks. Provision is made for reversing the flow. The channels are shaped to maintain approximately uniform velocities. To control the flow to each tank, orifice plates will be set in the three 12-in. cast-iron pipes which feed each tank, and adjustable weirs will be placed on the outlet. Each inlet also has a 12-in. sluice gate, the inlet being set 4 ft. 3 in. below the surface.

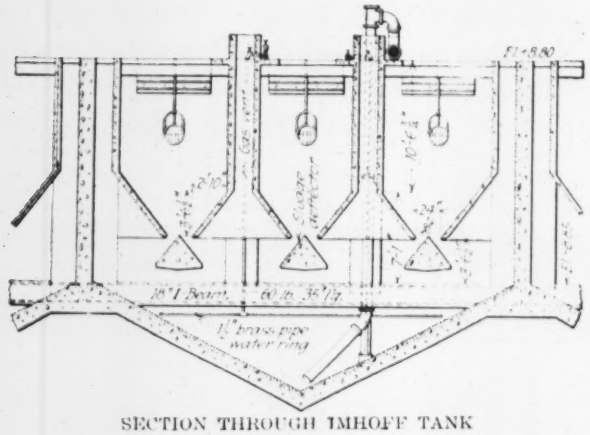
Imhoff Tanks—Each Imhoff tank unit is 103½ ft. long by 34½ ft. wide, with a total depth of 26.4 ft., including a freeboard of 18 in. There are three hoppers, each 8½ ft. deep with bottom slopes of 2 horizontal to 1 vertical. The settling chamber has a bottom baffle slope of 1 horizontal to 1.5 vertical. Each tank is designed to have a settling capacity of 29,000 cu.ft., or a detention period of 2.9 hr. with 1.77 m.g.d. flow. The sludge capacity is about 16,300 cu.ft. or 2.3 cu.ft. per capita. The ratio of vent to total tank area is 17 per cent. Slot openings are 8 in. Each sludge hopper is equipped with a water ring of 1½-in. brass pipe having ½-in.-holes, spaced 15 in. c. to c., pointing downwards and ½-in. holes, 48 in. c. to c., pointing up. The sludge will be removed from each hopper by an air lift in an 8-in. cast-iron pipe. Scum-boards are provided in front of each outlet weir, extending 12 in. below and 9 in. above the surface.

The buttresses of the 16-in. outside walls are tied together at the bottom. Over the center of the hoppers, 18-in., 60-lb. I-beams are used, and between the hoppers, nine 1-in. round bars. At the top the ties are eight ¾-in. round bars. The center supply channels are placed on a single wall to facilitate removal if the tanks are ever converted.

Sludge Beds—The sludge beds are designed on the basis of 1 sq.ft. of bed area for three persons. This may be low based on the experience at Columbus but ample provision is made for expansion when needed. In winter it is possible that the Imhoff sludge may be handled experimentally in the press and dry house. The beds are 66 ft. long by from 17 ft. 7 in. to 20 ft. 3 in. wide, underdrained by a 12-in. tile main drain with tight joints and two 4-in. tile lateral drains with open joints. The filtering material varies in depth from 12 to 19 in., consisting of a top layer of 1½-in. river or lake sand, then 3 in. of ⅛- to ¼-in. sand, 4 in. of ¼- to ⅝-in. broken stone or gravel and a bottom layer, 3½ to 10½ in. thick, of ⅝- to 2-in. broken stone or gravel.

For the removal of the sludge, 17-cu.ft. cars operate over a 24-in. gage industrial railway provided with 16-lb. rails on steel ties laid flush with the surface of the sludge beds. At the start the sludge will be dumped on vacant area.

Aeration Tanks—Each of the two aeration tanks is 103½ ft. long by 34½ ft. wide and has a water depth over the filtros plates of 14 ft. 4 in., the tank volume being 362,000 gal. Two longitudinal baffles divide each tank into three compartments giving a travel of 310 ft. With an average flow of 1.75 m.g.d., and 25 per cent allowed for returned sludge, the detention period is 4 hr. One tank is to be fed with the effluent of an Imhoff tank and the other with raw sewage.



SECTION THROUGH IMHOFF TANK

The bottoms are similar to those at the Desplaines River sewage works (see *Engineering News-Record*, Dec. 9, 1920, p. 1134) with pre-cast concrete containers each holding four filtros plates, set between precast ridge blocks. The ratio of gross plate to tank area is 1 to 4.21. Air is supplied by an 8-in. galvanized cast-iron main header, through 1¼-in. connections taken off the top of the main header. Venturi meters with continuous registering devices will measure the air and automatic steam traps will remove the condensation from the air pipes which are laid to drain.

Sludge is returned to the inlet end of the tanks by air lifts, equipped with V-notch weir measuring boxes feeding wooden troughs.

Aeration Settling Tanks—Each aeration unit is provided with a settling tank 34 ft. square at the top. From a depth of 5 ft. 4 in. below the flow they warp to a circular bottom. The bottom slope is 1¾ to 12 in. The central water depth is 15 ft. The aeration tank liquor enters the tank on opposite sides over 15 rectangular weirs, and pass under adjustable baffles set 2 ft. 10½ in. below the flow line. The effluent passes out over continuous overflow weirs on an effluent trough at the center. The sludge is swept to the center by a Dorr thickener, operated from an overhead bridge, and passes through an 8-in. outlet pipe under the floor to an air lift. The area of each tank is 1,135 sq.ft. which, with a flow of 1.75 m.g.d., gives a daily rate of 1,550 gal. per square foot.

The aerated liquor is conveyed from the aeration tanks to the aeration settling tanks in channels provided with filtros plates.

Sprinkling Filter—The sprinkling filter takes the flow from one Imhoff tank. It is 130 x 248½ ft. in plan, or 0.742 acre, and is constructed almost entirely above ground, being enclosed by a reinforced-concrete retaining wall. From the dosing tank, located on one side of the filter midway between the ends, runs the main feed header in either direction along one side—a 14-in. cast-iron pipe, reducing by successive sizes to 8 in. at the far end of the filter. Twenty 6-in. cast-iron laterals run across the filter from the main header and are supported just below the filter surface by the stone. The nozzles, tapped directly into the laterals, are of the Worcester circular type, with ⅜-in. orifices, 14 ft. c. to c., arranged at the apices of equilateral triangles. On alternate lines half nozzles are used adjacent to the filter walls. Each lateral has a shut-off valve to its junction with the main header and a blow-off valve at the far end discharging through a down pipe into the filter effluent channel.

The filtering medium consists of 5 ft. 10 in. of 1- to 2-in. crushed and washed limestone, underlaid by from 6 to 12 in. of 2- to 4-in. stone.

The underdrain system is of the Fitchburg type, consisting of alternate flat-topped ridges and collection channels. Over the channels are laid concrete bricks, 4 in. high and 1½ in. wide, staggered between alternate ridges. The underdrains have a summit at the center of the filter and discharge toward the two sides into the effluent collectors running to the secondary tanks.

Dosing Apparatus—Duplicate dosing tanks with hopper bottoms shaped to secure equality of distribution discharge by overhead siphons into a common feed tank supplying the main filter headers. Settled sewage from the Imhoff tank is discharged alternately into the two dosing chambers through a slot in the bottom of the pipe. The flow is shifted by an adjustable float-operated tipple plate. The filter is designed to operate at an average rate of 1.75 m.g.d. with 50 per cent increased allowance for storm flows, but provision was made in the designs of the dosing apparatus for increasing these rates by 50 per cent. The present average rate means 2.35 m.g.d. per acre with 9,400 people per acre.

Secondary Settling Tanks—The secondary settling tanks are two in number, of the Dortmund type, 30 ft. in internal diameter with a cylindrical portion 10 ft. 10 in. deep below the flow line and a hopper bottom 9 ft. 4 in. deep with side slopes of 3 horizontal to 2 vertical. Sewage enters at the center through a down-tube 3½ ft. square, extending 9 ft. 10 in. below the flow line and flows out over a peripheral gutter having 16 weirs, each 24 in. long. The effluent passes to the main effluent conduit.

Sludge, withdrawn through an 8-in. cast-iron pipe, flows by gravity to the press and dry house where it will either be mixed with the waste activated sludge and pressed and dried or be pumped into the raw sewage conduit and settled out in the Imhoff tanks for digestion.

The settling volume of each tank above the bottom of the downtake tube is approximately 54,500 gal. and the sludge hopper below the top of the cone 17,650 gal. With an average flow of 1.75 m.g.d. and both tanks in operation, the detention period is 1.5 hours.

In addition to the plant described other contracts cover an administration building, housing the laboratory and locker rooms; a blower house in which will be located the air screens and compressors, also the pumps to supply the sprinkling filters, and a press and dry house for the dryer and devices for reducing the original moisture of the activated sludge as removed from the tanks. The choice of apparatus between filter presses and centrifuges has not yet been made.

Until his resignation in December, 1920, this work was carried on under the general direction of E. J. Kelly, chief engineer of the Sanitary District of Chicago. Albert W. Dilling was made chief engineer when Mr. Kelly resigned. The engineering staff working on the plant includes the writer as sanitary engineer; C. R. Dart, chief structural engineer, since resigned; H. L. Steffa, mechanical engineer, and F. L. Barrett, architect. L. B. Barker, assistant engineer, is in charge of the construction of the conduits and treatment plant. L. C. Whittemore, assistant sanitary engineer, has been in charge of the preparation of the contract plans for the treatment plant under the direction of the writer. The T. J. Forschner Contracting Co. is contractor for the treatment works and the American Sewer & Drain Construction Co. for the conduits.

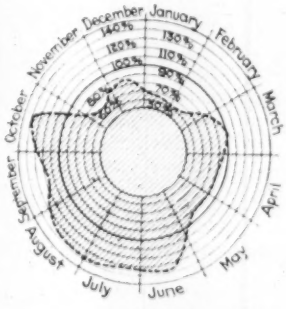
Traffic Study Proves Two-Lane Road Widths Sufficient

Figures Show 500 Vehicles Daily Represent Average Volume of Travel on State Highway Systems—Seasonal and Hourly Variations Noted

By A. N. Johnson
Dean, Engineering College, University of Maryland

Paper presented May 23 at the conference on Highway Traffic Regulation, held under the auspices of Yale University, New Haven, Conn.

THE public as well as highway engineers have been asking what may be the traffic that our highways will be called upon to carry. Are the provisions for width, for example, sufficient or should much wider roads—roads that will carry three or four lanes of traffic—be provided? It is of manifest importance to find some answer to this question. If it can be shown that the traffic that may be expected is within certain limits the plans for various state highway systems can be more accurately and scientifically made. It is not sound planning that makes



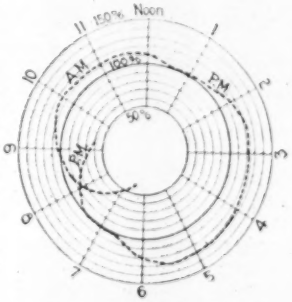


FIG. 1 (LEFT). SEASONAL TRAFFIC VARIATIONS ON WASHINGTON-BALTIMORE ROAD

Results obtained at St. Denis, near Baltimore, are plotted as percentages of the daily average traffic for the years 1917-1920, inclusive. The full circle is the average, taken as 100 per cent.

FIG. 2 (RIGHT). DIURNAL VARIATION OF TRAFFIC

Adapted from data in report on California highway system by U. S. Bureau of Public Roads, 1920. The full circle is the hourly average, taken as 100 per cent.

provision for a wider highway than a reasonable expectation of the traffic to be accommodated justifies.

As a basis upon which to attack our problem there are presented three factors which govern the amount and density of traffic upon the highways. These are: (1) The number of vehicles that use the highways; (2) the mileage actually made by these vehicles in a given time; and (3) the mileage of highways that are available for traffic. The larger the first two of these factors and the smaller the third factor, the greater will be the number of vehicles to be accommodated per mile of highway in a given unit of time. Keeping in mind the effect upon the resulting number of vehicles per mile per unit of time that will come upon our highways, the following statistics become very significant:

Nation's Vehicle-Mileage Computed

The total number of motor vehicles, including motorcycles, in the United States, from the latest available information as compiled by the U. S. Bureau of Public Roads, is placed at 9,449,441. While this number includes taxicabs and many other motor vehicles that seldom use highways outside of city limits, no deduction is made from the total as here given in the discussion which follows.

The average mileage made in a given time, say one year, by each motor vehicle is not known accurately. From data in the possession of the American Automobile Association it is estimated that an average of 6,000 miles yearly may be taken as reasonably approximate, while the U. S. Bureau of Public Roads places it nearer 4,500 miles per year per vehicle. Let us take the higher value of 6,000 miles and apply it to the total number of motor vehicles. There results a yearly mileage of approximately 57,000,000,000 vehicle-miles. As this total includes all vehicles, whether confined to city streets or using the highways, it is fair to assume that the highways as a whole today do not develop a total motor traffic in excess of 57,000,000,000 vehicle-miles per year.

The total mileage of highways in the United States, excluding city streets, is given by the U. S. Bureau of Public Roads as 2,478,552 miles. It is generally the opinion of those who have given the subject close attention that 20 per cent of the total mileage of all the highways carries not less than 90 per cent of all the traffic. As it may be some time before any considerable number of states will have improved 20 per cent of their total highway mileage, and as most state highway systems under construction today seldom exceed 10 per cent of the total highway mileage in the state (see Table I) it will be more significant to the present discussion to consider the amount of traffic that may be carried upon 10 per cent of our highways. The opinion generally prevails that we may expect 10 per cent of the highways, if judiciously laid out, to form a comprehensive state highway system to carry 75 per cent of all the traffic.

TABLE I. MILEAGE OF FIVE STATE HIGHWAY SYSTEMS—AS PER CENT OF TOTAL

State	Total Mileage	State Highway System— Miles	State Highway System— Per Cent of Total
California	61,039	5,560	9 1
Illinois	95,647	4,800	5 5
Iowa	104,074	6,619	6 4
Maryland	16,459	1,726	10 0
New York	79,398	3,772	4 7

Upon these data it is practicable to determine the traffic that would develop today on state highway systems were they completed. Seventy-five per cent of the total traffic is approximately 43,000,000,000 vehicle-miles per year, which is to be carried upon 250,000 miles of highways, or a traffic per mile per year of 172,000 vehicles. There thus results an average traffic per mile per day a little under 500 vehicles. It is evident from the rather large values given the factors that control this result that the actual traffic is probably well within the value here found.

Seasonal Variations of Traffic

The average daily traffic throughout the year does not give the number of vehicles that should be provided for, due to the seasonal and diurnal variations in the volume of traffic. A road must carry comfortably the usual increase over the average traffic that comes regularly at certain seasons and during certain hours of each day.

The seasonal variation that occurs will vary due to climatic conditions. In the vicinity of Baltimore on the Baltimore-Washington road the seasonal traffic variations are shown in Fig. 1. From this diagram it is noticed that from the middle of June until the middle of October the daily traffic is about 135 per cent of the average daily traffic for the year. The traffic records available in Maryland do not show the hourly variations which, however, are brought out from the data presented in a report on the California highways by the U. S. Bureau of Public Roads and have a fairly wide application. In that report the results are plotted to rectilinear co-ordinates, which are here shown (Fig. 2), plotted to polar co-ordinates. From this curve it is seen that the maximum hourly traffic is about 30 per cent in excess of the average hourly traffic for the day. It is this high hourly average traffic occurring during the months of high average daily traffic for which provision should be made. If the average daily traffic for the year is 500 vehicles, the daily traffic during the heavy traffic months is 675. Based on a twelve-hour day this gives

an average hourly traffic of 56 vehicles, and a high average hourly traffic of 73 vehicles. If the daily average is 1,000 vehicles then an hourly traffic of 146 vehicles may be expected.

It will now be interesting to compare with these figures the traffic discharge of a two-track road, i.e., a road which accommodates two lanes of traffic. During the rush-hour on many roads a large proportion of the traffic at a given point is in one direction—just what proportion cannot be stated without much more data at hand than are available. It will be assumed, however, that all of the traffic is in one direction and is confined to a single lane.

The number of vehicles that pass over a given road will be designated as the vehicle discharge. The number of vehicles that may pass a given point in single file or the total discharge of a single lane of traffic depends upon the velocity and the spacing or interval between the vehicles. If the velocity is expressed in miles per hour and the distance from the center of one vehicle to the center of the next in feet, the total number of vehicles that will pass a given point in one hour is equal to 5,280 times the velocity in miles per hour divided by the distance in feet from center to center of the vehicles or $N = 5{,}280\ V/D$.

The accompanying traffic discharge diagram (Fig. 3) enables comparisons to be made readily under varying conditions. If the distance from center to center of vehicles remains constant, then it is clear that the number of vehicles passing a given point will vary according to speed in miles

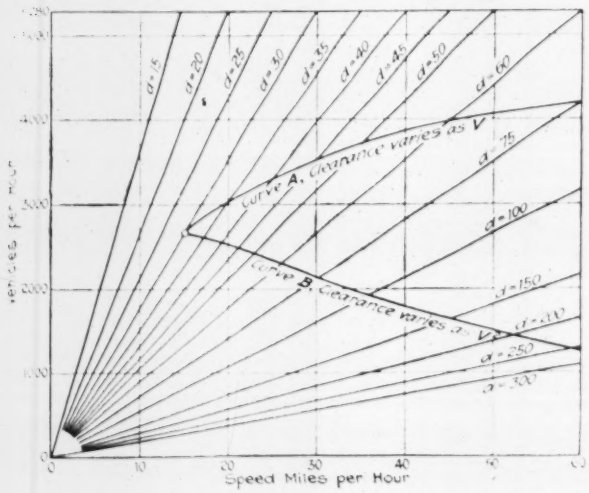


FIG. 3 TRAFFIC DISCHARGE DIAGRAM FOR SINGLE LINE OF VEHICLES

d = distance, center to center, of vehicles.
$d - 15$ = clearance between vehicles.

per hour, and we have the series of straight lines as shown in the diagram. Thus, taking the average overall length of vehicles as 15 ft. and a clearance of 15 ft., D becomes 30 ft. and for a speed of 15 miles per hour the discharge of a single traffic lane will be 2,640 vehicles per hour. This point on the diagram has been taken as the starting point for the two discharge curves A and B. In curve A the clearance between the vehicles is assumed to vary directly as the velocity. Thus, if the speed be increased to 30 miles per hour, the clearance is increased 15 ft. or a total distance of 45 ft. and the total number of vehicles that pass in an hour is 3,500. For the lower curve, B, the clearance between the vehicles is taken to vary as the square of the velocity. Thus, at 30 miles per hour as compared with 15 miles per hour, the clearance is increased four times or 60 ft. Add to this the length of one vehicle and we have the distance from center to center, D, equal to 75 ft., and the number of vehicles passing is 2,150 per hour.

From some observations made on traffic on the Washington-Baltimore road during a special rush hour it was observed that vehicles moving 25 to 30 miles an hour in

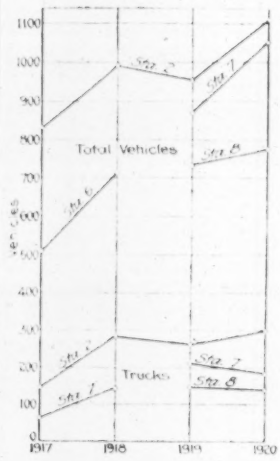


FIG. 4. INCREASE IN TRAFFIC AT VARIOUS POINTS ON WASHINGTON-BALTIMORE ROAD

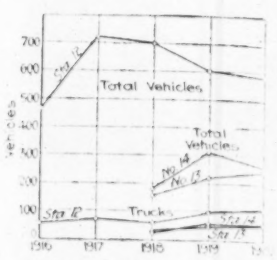


FIG. 5. AVERAGE DAILY TRAFFIC ON YORK ROAD

groups of 6 or 7 did not space themselves nearer together than 50 to 60 ft. or, allowing for the length of the vehicle, the distance between centers was about 75 ft. It was also observed that vehicles moving 10 to 15 miles per hour frequently were spaced as close as 15 ft. or about 30 ft. center to center. This indicates that the clearance between vehicles may be taken to vary as the square of the velocities within practical road speeds.

If the clearance between vehicles does vary as the square of the velocity we have the interesting fact that a larger number of vehicles will pass a given point at a speed of 15 miles per hour than at 30 miles per hour.

As a matter of fact the greatest number of vehicles observed on the Baltimore-Washington road did not exceed 400 per hour, the average speed being about 25 miles per hour which would require an average spacing of 330 ft. If 1,000 vehicles were to pass in a single file in one hour at a speed of 25 miles per hours the spacing, center to center, of vehicles would be 132 ft. Thus a highway paved for a width to accommodate two lanes of traffic can readily handle a total traffic in both directions of 1,000 to 1,500 vehicles per hour and temporarily, during a special rush, may handle over twice these amounts.

Observed Traffic Volume

Traffic on the Baltimore-Washington road for 1920 is somewhat in excess of that for 1919 and 1918. The average number of vehicles per day per mile was 1,000 for the year 1920. In Fig. 4 are shown the curves of increase in traffic at various points on this road for the past few years. All of these diagrams are based upon traffic counts taken for a period of 12 hours during one day each month, although at some of the stations during certain months no counts were made. A diagram similar to Fig. 4 has been made for the York road, as shown by Fig. 5. The York road leads northerly from Baltimore, but does not carry much, if any, through traffic, i.e., traffic from one large center of population to another, as in the case of the Baltimore-Washington road. On the York road a slight decrease in traffic has occurred during the past few years.

The following data are presented for comparison with similar data presented in the first part of this paper. There were in Maryland in 1920 approximately 125,693 motor vehicles and a state highway system of 1,726 miles, practically completed, so that traffic may be said to have found the roads and the roads have received their traffic. On the bases before assumed that each motor vehicle travels 6,000 miles a year and that 75 per cent of all such travel comes upon our state highway system (that of Maryland being very close to 10 per cent of all the highways) we have a total travel of 565,618,500 vehicle-miles or a daily average of 900 vehicles per mile. This agrees closely with the traffic noted on the Baltimore-Washington road, which was seen to be about 1,000 vehicles per day on the average throughout its length. The York road averages much less

Time has not permitted careful analysis of the traffic records of all the roads of the state highway system of Maryland, but it is to be noted that there are some roads averaging well over 1,000 vehicles per day, while the larger portion of the state highway system receives much less traffic. Thus it is probable that the traffic as here computed to come upon our state highway systems is reasonably close.

The traffic upon the roads of the Maryland highway system is not increasing at an extraordinarily rapid rate; in fact, in some instances it actually decreased for 1920. The explanation is not difficult to find. The number of motor vehicles is reaching a practical limit of man power to drive them, the numbers of owners possessing more than one motor vehicle is increasing, thus decreasing the average yearly mileage made by each motor vehicle; the use of roads other than the state highways is increasing. All of these conditions combine to produce a retarding effect on the increase of traffic upon the main roads of the state.

In conclusion it may be stated that there is no reasonable expectation that our main roads comprising the state highway systems, when completed and carrying their full quota of the traffic, will be called upon to carry on the average more than 500 vehicles per day throughout the year, so that a highway paved for a width sufficient to accommodate two lanes of traffic will suffice for many years to come. It is not to be concluded that there are no sections of highways that will not require more than two traffic lanes, but the mileage of such routes is and will continue to be but a small fraction even of the restricted mileage of the state highway systems. Any highway plans contemplating an extended system of highways constructed for a greater width than required by two lanes of traffic are extravagant.

Ruling on Ethics of Dual Allegiance

The Council of the American Institute of Consulting Engineers has recently passed upon a hypothetical question of professional ethics, listed in their rulings as Case 18. The ruling is as follows:

Statement.—In a case involving the respective rights of a water-supply company owning the surface water rights over certain lands, and the owners of the lands, a (supposedly) friendly suit at law is instituted to determine the legal status of the parties. An engineer, employed in the inception of the water-supply project, is asked by the land owners to accept a retainer as expert witness in their behalf. The engineer consulted the officials of the water company who stated that they (the water company) had intended to retain him as expert witness in their case, but that there would be no objection whatever to his testifying on the other side, since his testimony would no doubt be the same in either case. After further conference with both parties and having their assurance that his action would be satisfactory to both, be accepted the retainer of the land owners.

Question.—Was the action of the engineer in accordance with correct professional ethics?

Answer.—The circumstances in this case are somewhat unusual, inasmuch as the suit at law is represented as being a "friendly" one to determine the legal status of the parties thereto; and that the retaining of the engineer by one of the parties was with full knowledge and consent of the other.

The acceptance of the retainer under these conditions was permissible and should not be regarded as unethical.

Sand and Gravel Production

According to a recent bulletin issued by the United States Geological Survey, the total quantity of sand and gravel produced in 1920 was nearly 78,000,000 tons, or about 7,000,000 tons in excess of the 1919 output, a total value increase from about $46,000,000 to more than $62,000,000. The production of building sand increased nearly 4,000,000 tons. The output of molding sand increased more than 1,000,000 tons.

How Labor Union Working Rules Raise Building Cost

Some Impeding Regulations Imposed on Contractors Are Cited by C. R. Gow, Who Had Charge of Boston Army Base

UNDER the title "The Responsibility of Organized Labor for the Stagnation in the Building Industry," Charles R. Gow read a paper recently before the Boston Society of Civil Engineers reciting in detail a number of the rules and agreements under which the various labor unions in the building trades work. These rules are mandatory and no contractor operating a closed shop can conduct his business without obeying them. They are, according to Col. Gow, the most serious cause of the inefficiency in present-day building operations and one of the principal causes of the high cost of construction. Col. Gow is a well known Boston engineer and contractor and during the war was the army officer in charge of the construction of the Boston Army Base, which work was carried out under the Baker-Gompers agreement—a closed-shop plan.

The following paragraphs set down some of the more important rules which serve to impede construction progress:

Rules Affecting Foremen

Substantially, all working rules require that foremen shall be members of unions. The effect of this provision is to subject the foremen to two conflicting influences. If he is loyal to his employer he may be deemed offensive to his union; and if he satisfies the union, it often is because he has been disloyal to his employer.

During the construction of the Army Base a foreman's union card was taken from him and he was debarred by the union from further connection with the work. Upon inquiring of the union officials I was informed that the charge heard against him was that he used profanity to the men. It appeared that his case had been considered by a secret tribunal which had recommended his expulsion, and the findings were approved by the union membership. The records showed that he was one of the most efficient foremen on the work in the matter of low production cost and satisfactory workmanship. It seemed clear to me at the time that he had been disciplined because of too much insistence upon results from his men.

The trade rules of the carpenters' district council provides that "While all foremen should prove their efficiency as such they shall not rush, use abusive language or otherwise abuse workmen under their direction. A violation of this rule is punishable by a fine, expulsion from the job, or both."

The rules of the plumbers' union provide that "It shall be the duty of all foremen to report any man late on the job to his employer at the time it occurs." This rule appears to be commendable in its nature until it is explained that the union insists that, inasmuch as this is the only expressed stipulation of its kind in the rules, it therefore follows that the foreman can report only this infraction and no other to his employer.

A foreman in the painters' union is prohibited from commenting as to whether a man is doing a proper or improper amount of work.

The electricians and lathers both submitted demands Jan. 1 last requiring that on jobs employing three or more men a foreman shall be employed, or at least one of the men should receive a foreman's pay.

Another matter which has been taken from the employers' control by the unions is that of selecting and employing apprentices in the several trades. Young men desiring to learn a trade in former years were accustomed to apprentice themselves to an employer who undertook to train them and eventually fit them to serve as finished jour

neymen. This system some years ago became offensive to the unions because it was believed that too many journeymen were being educated for the welfare of the unions. Also apprentices were used for many of the simpler duties to the exclusion of union journeymen. Therefore, the unions ultimately insisted that apprentices should be furnished only through the unions.

Since that time many rules have been established by the unions regulating the selection, employment, and work of apprentices. The general tendency has been to restrict greatly the allowable number of such apprentices and to select them with regard to their union proclivities and affiliations.

Limitation of Equipment

As to rules which prohibit work being done in the most economical manner it is provided by the plumbers' and steamfitters' unions that all piping up to 2½ in. in diameter must be cut on the job by hand. It would, of course, be very much cheaper to have all of the piping cut to exact measure in the shop, using power machines for the purpose, or even to cut it on the job using power.

The ornamental work in plastering was once cast in molds at the shop and erected as units by the plasterers. Now the union requires that all of this work must be done in place by hand work. Paint-spraying machines have recently been invented which may be effectively used for painting flat surfaces. Government tests have demonstrated their efficiency and cheapness as compared with hand painting. The rules of the painters' union, however, prohibit their use. The painters' union also prohibits the use of a brush more than 4½ in. wide in applying paint by hand. The plasters' union specifies the particular size of hod to be used and also requires that no bag material shall weigh more than 100 lb. The evident intention of the rules just referred to is to make work for more men regardless of economic considerations.

Another group of rules is aimed to compel the use of high-priced, skilled mechanics to do unskilled work which any intelligent laborer might do. For example, plumbers must handle all plumbing materials after they have been delivered on the first floor. An employer might prefer to lift the bathtubs for the upper stories by means of a derrick, but the rules provide that they must be handled by plumbers. Automatic electric pumps are frequently installed for permanent drainage of subways and deep basements, and are found to require only occasional inspection for oiling. On a construction job, however, such a pump requires the constant attention of a union engineer at $1 per hour. Similarly, a small gasoline-driven diaphragm pump of the type formerly operated by hand now requires a union engineer, although any intelligent water boy is competent to do the actual work required of him in addition to his other duties.

Overtime Pay

A steam-operated derrick engine on a certain job properly required a hoisting engineer. An electrically driven concrete mixer on the same job did not necessarily require a skilled engineer, but employed one nevertheless. On the same job there were two other machines installed, an electrically operated cable drum for hauling charging cars, and a small air compressor also electrically driven to furnish air for some jack hammers. The union temporarily could not supply engineers for the two latter machines, but provided that the wages which would have been paid to an engineer on the compressor should be divided between the two members of the union who were employed. Also it was directed that upon any day on which the cable drum was operated an additional two hours' pay should be allowed one of these men. No service was rendered by these men in connection with the operation of either machine, but each man received twelve hours' pay for eight hours' work, and if the second machine was operated one man was allowed fourteen hours' pay for his eight hours' work.

On another job two piledriver engines were employed, each operated by a union engineer. Two small electrically driven concrete mixers were in use at the same time and the only labor required to be done upon them was that of throwing in the switch to admit the electric current. This work was done by the concrete foreman. The union required that each engineer on the piledrivers be paid two hours' extra each day, although neither engineer ever tended the apparatus in question.

The carpenters' union requires that all temporary work, such as erecting working stagings and the like, shall be done by union carpenters; also that the stripping of forms from concrete surfaces must be done by carpenters, although it has until very recently been done in a perfectly satisfactory manner by laborers.

All men employed on or around piledrivers and lighters which are engaged upon wharf building, except the engineers, must be union wharf builders, a branch of the carpenters' union. Many of these men do purely laboring work, but because of their rating draw skilled men's pay.

For several years after reinforced-concrete work was introduced into this locality the steel reinforcing bars used to strengthen the concrete were handled and placed by common labor. Later it was provided in the rules of the iron workers' union that all of this work should be done by members of that organization. A recent job in this locality was done by a non-union contractor using laborers to handle and place the reinforcing steel at a cost of $7 per ton. A similar union job going on at the same time required union iron workers for this purpose at a cost of $37 per ton.

Mechanics Have Specific Tasks

Union iron workers must also be used to do any work in the nature of rigging; that is, the erecting, dismantling or operating of derricks (other than operating the engines); loading or unloading of machinery; erecting, moving or dismantling towers, chutes, etc. At the Army Base job there were used a large number of very light derricks hoisting small buckets out of the foundation excavation. The men actually used for signaling the engineer when to start and to stop were recruited from various walks in life, some being former street sweepers, some retired bar tenders, others having served as janitors, but all at that time rated under a union permit card as skilled union iron workers.

Stoves used at night for the drying out of plastering may not be looked after by the ordinary watchman, but must be attended by a member of the plasterer tenders' union. Similarly all dirt or debris made by the plasterer must be cleaned up by a union tender and not by unskilled labor.

Union plumbers must be used to lay temporary piping for construction purposes only, as well as the suction and discharge piping of pumps. Union sprinkler fitters must be employed to lay underground cast-iron pipe which conduct water to the sprinkler system, and union plumbers similarly must lay cast-iron water pipe connecting with the building plumbing. Neither of these trades is as efficient as a trained labor gang experienced in this class of work.

Unions' Power Over Contractors

There are numerous rules of a purely dictatorial character which serve to restrict the employer in the exercise of his natural functions, as, for instance, the plumbers' rules provide that the employing plumber, or one of them if it is a firm, may do so-called jobbing work in the shop provided he does not do more than 50 per cent of all the jobbing to be done. The plasterers' union rules provide that "the employer shall be allowed the privilege of closing his weekly payroll on Thursday night in the Greater Boston district."

A revised constitution of the lathers' international union adopted at the annual convention at Toledo in September of last year provides that "all locals shall have power to regulate the granting of permits to contracting lathers, provided: First, that the fee charged the contractor or solicitor shall be left to the discretion of each local but not to exceed $100 and the resident limit cannot exceed one year." The effect of this rule is actually to prohibit any contracting lather from doing business unless he first se-

cures from the union a permit not to exceed the sum of $100, which permit must be renewed yearly.

The lathers' union rules also contain a provision that men working less than four hours shall be entitled to at least four hours' pay and if more than four hours he must be paid at least eight hours' pay.

The painters' union requires that men shall not go to the shops for tools or materials during the noon hour, but may only do so during the working time. Similarly, the lathers' union provides that men shall not be shifted from one job to another during the noon hour.

Both lathers' and plasterers' unions insist that when employers have occasion to do work within the jurisdiction of another local 50 per cent of the men must be hired from that local. The lathers' union specifies the particular kind of nails and staples which the employer must furnish.

Pay While Not Working

The hoisting engineers' union directs that men who report for duty shall be paid two hours' pay for reporting if not put to work unless they have been notified at the end of the previous shift not to report. Thus, if it happens to be stormy in the morning so that no work can be done, the engineers must still be paid $2 for reporting. If an engineer is put to work at all on the day shift he is entitled to at least four hours' pay and eight hours' pay if he starts to work on a night shift. The engineer must be paid one hour's pay for getting up steam, which work he shall do unless the night watchman is also a licensed man, in which case the latter may get up steam for the engineer.

If any work is done or with an engine during the absence of the regular engineer, he must be paid just as if he had been present. In one case an engineer was requested by his employer to work on Saturday afternoon and Sunday in order to make some needed repairs on his engine so that the work would not be tied up on the following Monday. The engineer refused because of another engagement. Thereupon the employer hired some machinist from a near-by shop who made the desired repairs. The engineer subsequently made a claim for and received pay at double-time rates for the period during which the machinist worked.

Some steel reinforcement was placed by union iron workers on a Saturday. On the following Sunday a gang of laborers was used to place concrete around the rods. The steel was found to be not in its correct position, and so was taken out and replaced by the laborers. The iron workers subsequently demanded and received pay for the work as if they had been present.

A hoisting engineer can be used to operate only a particular machine. Even though his engine be temporarily idle he cannot be shifted to another, but a second man must be employed for this purpose. On one job some repairs were to be made upon a large grab bucket. Machinists were brought out on a Sunday to do the work. An occasional lift by means of a derrick was required for a few minutes at a time. An engineer who was on duty looking after the pump was competent to do the necessary work, but he could not be used because the rules required that the regular engineer on the derrick was the only man who could touch the machine at any time. As a result the regular man was used and paid at double-time rates to make about six or eight lifts, while the other engineer was an interested spectator. Incidentally it costs an engineer $5 fine if he is caught breaking this rule.

Miscellaneous Regulations

A hoisting engineer not only must confine himself to his own machine, but he must not furnish steam to a second unit until he receives two hours' extra pay per day for so doing. Furthermore, not more than one extra machine can be attached to his boiler. No engineer is permitted to take the place of a discharged engineer without first securing the permission of the business agent of the union.

Practically all the unions have adopted a rule that members must be paid off during working hours and are entitled to pay at overtime rates for all time while waiting for pay after hours.

The cement finishers' union insists that the employer cannot hire his men direct but only through the union office.

A contractor cannot choose which engineer he desires to keep when one or more machines are shut down. He must release the man whose engine is dispensed with even though this be his best man.

Engineers are not allowed to operate the water valve on a concrete mixer although the valve is purposely placed within easy reach of the operator of the machine. The engineer must step aside each time the mixer is turned to allow a laborer to take his place for a few seconds to turn the water valve.

The electricians' union rules require that members working in the harbor shall be paid from time of leaving to return, and in no case for less than a full day. The minimum period for which an electrician may be paid is one-half day. The 1921 demand of the engineers' union provides, respecting overtime, that "an engineer shall receive not less than two hours' pay for any fraction of an hour's work." The stone cutters' union, in order to penalize any work done outside of its jurisdiction, provides that its rate of pay shall be 5c. an hour more than the normal rate for work done on stone which has been partially worked elsewhere.

A certain wood carver paid his men the union rate and in addition gave them a bonus for all work over a definite amount. The union agent upon discovering this fact ordered the practice stopped on the ground that it served as too much of a spur to the men.

Jurisdictional Disputes

One of the annoying and expensive features of trade unionism in the building industry is that pertaining to jurisdictional disputes. There are some twenty-seven separate trade unions which have to do with building work. Frequent questions arise between them as to which one is entitled to do certain work. For instance, carpenters and iron workers quarrel over the question of which has the right to set steel sash and door frames. The iron workers and steam fitters both claim the right to install pipe railing.

Electricians and elevator constructors disagree over the placing of certain devices in connection with electric control. Iron workers and metal lathers both claim the work of placing steel reinforcing. Cement finishers and bricklayers each insist upon pointing around steel sash. Stone cutters and cement finishers each claim the rubbing down of concrete surfaces.

During the construction of the Army Base a number of pulsometers were used in connection with the foundation work. They required frequent relocating and each time they were removed it necessitated the use of two steam fitters to disconnect and reconnect the steam pipes; two plumbers to remove and replace the suction and discharge pipe; then iron workers to hoist and lower the apparatus in the holes and an engineer to turn the steam valve. The engineer and a good laborer could have done all of the work required in much less time and in an equally satisfactory manner.

Four-Inch Gun Travels 25 Miles Per Hour

A 105-M.M. howitzer, recently tested at Fort Winfield Scott in San Francisco, is mounted on a tractor which can travel over highways at 25 miles per hour. The gun and its mounting complete weighs 6½ tons. A caterpillar tread is used, the width of the track being 12 in. and the length of the ground-contact 81 in. The driving mechanism is similar to that with which the army tanks were equipped, except that rubber is used on the sprockets and plates to reduce the vibration of high speed travel. The new gun, which is reported to have made a very creditable showing in the San Francisco tests, was made by the Holt Manufacturing Co. of Stockton, Cal.

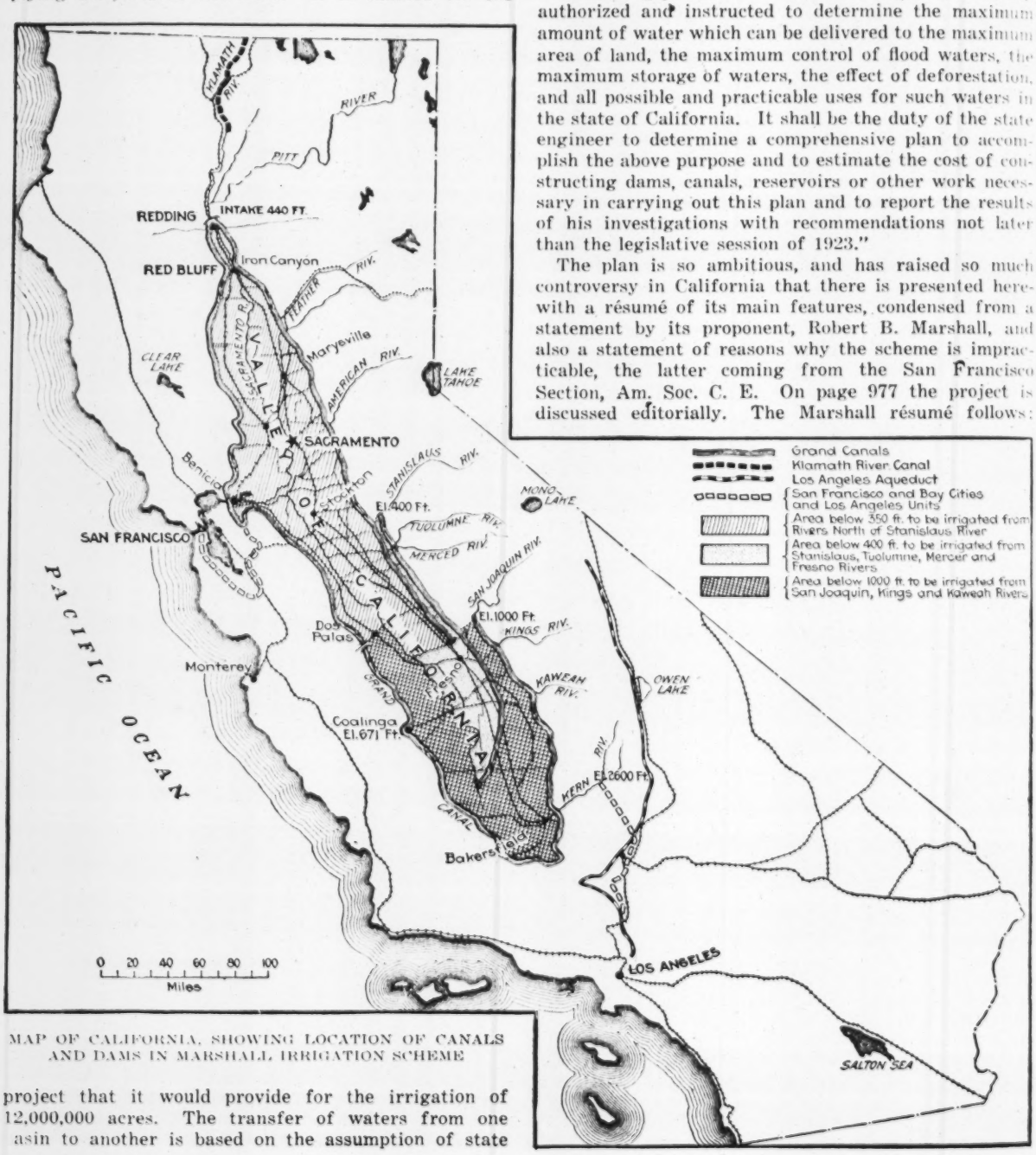
The Marshall Plan for Utilizing California's Waters

Résumé of Proponents' Statement of Vast Project and of the Objections Made by Various California Engineers

THE Marshall plan is a program for a statewide development of the water resources of California. By means of reservoirs in the great central valley of the state and canals it is proposed to utilize all the important streams of California for irrigation, power and domestic uses in accordance with a plan for supplying all parts of the state. It is claimed for the project that it would provide for the irrigation of 12,000,000 acres. The transfer of waters from one basin to another is based on the assumption of state control of all water rights. A most extensive promotion and publicity campaign favoring the scheme is being conducted in the state, with an appropriation of $500,000 for an engineering investigation as an immediate goal, but with the adoption of the Marshall scheme as the ultimate aim.

While the campaign did not succeed in getting the $500,000 appropriation, the Crittenden bill, just passed by the legislature and signed by the Governor, carries an appropriation of $200,000 for the investigation of possibilities for storing, controlling and diverting water for public use throughout the state. The act contains the following provisions: "The state engineer is hereby authorized and instructed to determine the maximum amount of water which can be delivered to the maximum area of land, the maximum control of flood waters, the maximum storage of waters, the effect of deforestation, and all possible and practicable uses for such waters in the state of California. It shall be the duty of the state engineer to determine a comprehensive plan to accomplish the above purpose and to estimate the cost of constructing dams, canals, reservoirs or other work necessary in carrying out this plan and to report the results of his investigations with recommendations not later than the legislative session of 1923."

The plan is so ambitious, and has raised so much controversy in California that there is presented herewith a résumé of its main features, condensed from a statement by its proponent, Robert B. Marshall, and also a statement of reasons why the scheme is impracticable, the latter coming from the San Francisco Section, Am. Soc. C. E. On page 977 the project is discussed editorially. The Marshall résumé follows:



MAP OF CALIFORNIA, SHOWING LOCATION OF CANALS AND DAMS IN MARSHALL IRRIGATION SCHEME

From a diversion dam to be built across the Sacramento River just above Redding, water would be carried in large canals down each side of the Sacramento Valley and thence up each side of the San Joaquin Valley. These main canals would operate by gravity, siphons or pumps as may be expedient. On the main west side canal opposite San Francisco a large supply would be diverted for the use of that city and vicinity. The main east side canal would be twice ended and each time started again at higher levels where new supplies are available. Separate in construction and operation from these two systems, a third system or Los Angeles unit would be dependent upon the Kern River which would be diverted through a long tunnel for use in southern California. To offset the diversion of the Kern River waters from the San Joaquin Valley, the Klamath River would be diverted below Klamath Falls and carried into the upper Sacramento River near Shasta Springs. Above all these main canals the tributary streams would be drawn upon through reservoirs to be built along their courses. Further flexibility of the total flow would be provided by additional storage below the canals.

The funds for this development would be raised through a state-authorized bond issue, and the interest on these bonds would be met by revenue from the sale of hydroelectric current to be generated as construction proceeds. A surplus would be created for maintenance, depreciation, etc., leaving the users of water to pay the cost of construction by the purchase of water from the state for a period of say fifty years.

The Klamath River would be diverted at El. 4,000 ft., taken by tunnels and canals for a distance of 40 mi. over Shasta Pass at El. 3,792 ft. and dropped 1,250 ft. into the Sacramento River near Shasta Springs. This would develop 375,000 hp. and add more than 2,000,000 acre-ft. to the water supply of the central valleys.

The east side main canal would leave Redding at about El. 440 and would flow southeast on a grade of about 6 in. per mile, picking up water from each stream traversed. This canal would follow the foothills on the east side for most of its length and would end at a point where it approached a crossing of the San Joaquin River. Above this point a second section of the east side main canal would start from a diversion dam on the Stanislaus River at about El. 400 and be carried thence high above and east of Fresno to a point above Tulare Lake. A third section would start from about El. 1,000 on the San Joaquin River and flow south past Bakerfield, around the south end of the San Joaquin Valley and thence north again on the west side.

The west side main canal would leave Redding at about El. 440 and would flow south along the foothills through Creston Pass, delivering water at Benicia at El. 300 where an inverted siphon would carry it across Benicia harbor. The route would pass thence through the Martinez tunnel, into the Concord Valley and up the west side of the San Joaquin Valley toward the terminus of the other canal built around the head of the valley. A dam would be constructed across Carquinez Straits to prevent the encroachment of salt water into the central valleys.

San Francisco would be served direct by means of a pipe line laid on the Dumbarton dam, a structure which would be built across the lower end of San Francisco Bay to reclaim the marsh lands south of that point. The Santa Clara Valley, as well as Oakland, Richmond, Berkeley and Alameda, would be served by a supply brought in by canal and tunnel lines from the main west side canal.

The only ample water supply for southern California lands not now served is the Kern River. This could be made to supply all the water southern California can reasonably get and perhaps all that territory would need for 150 years. To accomplish this a 300-ft. dam would be built across Kern River impounding a reservoir with a surface area of 40 sq.mi. at El. 2,700 ft. This supply would be taken through a 33-mi. tunnel to a crossing about 700 ft. under the present Los Angeles aqueduct in the Mojave Desert. Continuing south to a point near Clearwater, about 90 mi. from the Kern reservoir, the conduit would drop about 300 ft. to another intersection with the present aqueduct, which would be paralleled from that point on. For additional storage and power, four 200-ft. dams would be built on the south fork of the Kern River, developing a total drop of 4,000 feet.

In conclusion it is recommended: (1) that the California Legislature appoint a committee of five to report within three months as to the general practicability of the proposed plan, and make the necessary appropriation for the expenses of this investigation. (2) That upon a favorable report from the committee the Legislature at once enact the necessary measures to put these plans into effect. (3) That Congress be requested to allow railroad and highway bridges to be built across the straits of Carquinez and to turn over the control of the navigable portions of Sacramento and San Joaquin rivers to California.

Views in Opposition to Marshall Plan

The San Francisco Section, Am. Soc. C. E., after thorough consideration of the Marshall plan, and in accord with the advice of engineers with many years of irrigation experience, cites a number of reasons why the Marshall plan is not feasible. Some of these are extracted in the following:

(1) There are no storage sites in the main Sacramento River basin that can be used for storing anything like the total flow of the Sacramento River.

(2) One-half to one-third of the Sacramento River flood waters must waste into the ocean—the only way to store these floods would be in reservoirs located in the main river channel itself and such reservoirs are not available. Thus, only part of the largest floods can be stored and this part is not more than sufficient to supply irrigable areas in the Sacramento Valley itself.

(3) If some statewide canalization project were feasible, its cost must be many times that of present irrigation projects which are costing all that the irrigated areas can afford to pay for water.

(4) The attempt to divert water from almost every important stream in the state into other watersheds would result in endless litigation over water rights.

The following has been taken from a review of the Marshall plan prepared by V. S. McClatchy, for many years president of the California State Reclamation Board:

The Marshall plan is a slight modification of a plan suggested tentatively, and in the absence of engineering data, in 1874 by D. S. Alexander, G. H. Mendel and George Davidson, and which was presented before the flood control committee of Congress in 1916 in an endeavor to defeat the Sacramento Valley bypass system which is now being carried out. My report on this, made as president of the Reclamation Board, pronounced the project practically impossible and perhaps physically impossible, as well.

How shrewdly the old plan has been revived for promotion purposes and why it has met general support after superficial examination becomes apparent when it is noted that the present scheme promises everybody something—and frequently something which he had no hope of obtaining. The arid lands west of the San Joaquin River, which have no available water supply, are promised water from the east side of the San Joaquin. The insufficient supply on the east side of the San Joaquin is to be replenished with water from the Sacramento. The Sacramento Valley itself is promised water from floods now wasting in the sea. Los Angeles and the south, always hungry for water, are promised the entire flow of the Kern. San Francisco and San José are offered water for municipal purposes and so on.

If the Marshall plan cannot be carried out, its promotion at this time will do the state serious injury. Real estate speculators are preparing a campaign to sell at liberal prices blocks of land which have no water for irrigation and which have had in the past no available sources of supply, but to which the Marshall plan promises adequate irrigation facilities.

All engineering authorities who have investigated the matter agree that most of the available reservoir sites in the Sierras are above and not below the sources of flood and therefore of no value in conserving flood flow, and that the known available reservoir capacity below the sources of flood is entirely inadequate to hold back even the ordinary floods.

The Sacramento River flood control report (House No. 616, Session 1916) states that to carry a flow of 200,000 sec-ft. (one-third the excess flow of the Sacramento) would require a canal 1,800 ft. wide and 20 ft. deep, if built on a grade of 0.8 ft. per mile. Suppose a canal of only half this capacity were sufficient for the Marshall plan. Would any engineer assert the practicability of constructing a canal of this size along the foothills of the Sierras, commencing at or above Red Bluff at El. 400 to 500 and running down into the San Joaquin Valley? If physical obstacles and property that might be damaged by a break in such a canal did not prevent its construction, would not the cost alone end further consideration of the plan? The canal considered in the Congressional report above referred to, extending from Red Bluff to Dos Palos, was estimated to cost $700,000,000 under most favorable conditions in 1916.

The maintenance of such great canals high above the Sacramento Valley would be a menace to the inhabitants of the valley below them. Breaks cannot be prevented with certainty and would have to be expected. When they occurred the result would be enormous damage and probable loss of life and there is serious question at to whether breaks at certain critical points could be repaired without almost prohibitive cost.

Promotion of the Marshall plan is retarding development. The promises made by the promoters are of such universal application that they would call for an entire change in the state system of water distribution. Land owners hesitate to go forward with present plans in the doubt as to whether their local sources of supply are to be commandeered and used in a statewide distribution system.

Any investigation aimed toward improving present conditions is worth while; but let us not deceive ourselves nor assist the bunco fame of a few real estate speculators who care more for their own profits than for benefit to their customers or the prestige and permanent welfare of the state.

This suggestion is not intended in any way as a reflection upon Mr. Marshall, whose good faith in this matter is not questioned and whose abilities in his own field are fully recognized.

For previous references to the Marshall plan see *Engineering News-Record*, Feb. 10, 1921, pp. 273 and 277, and April 7, p. 606.—EDITOR.

State Co-operation in Steam Gaging

Thirty-three states and several municipalities are co-operating in the stream gaging work of the Water Resources Branch of the U. S. Geological Survey, congressional appropriations being inadequate for the investigations needed. This condition was stated in a paper read at the recent meeting of the National Drainage Congress by N. C. Grover, of the U. S. Geological Survey, in order to make plain that any considerable extension of the steam-gaging work is impossible at present. From these outside sources more than $160,000 were made available during the past fiscal year. The Federal appropriation was $175,000, which must provide also for the cost of investigations of ground water and quality of water. The demand for additional work is insistent in states already co-operating and also in states where little or no work is now being done. To meet this demand and to provide for increased cost of work due to the depreciation of money values, the estimates for stream gaging for the next fiscal year have been increased to $300,000.

Principles of Traffic Regulation on City Streets

Trained Officials the First Requisite—Education of Public Important—Uniformity Needed in Traffic Codes

By WILLIAM P. ENO
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Paper presented May 23 at the Conference on Highway Traffic Regulation held under the auspices of Yale University, New Haven, Conn.

THE science of highway traffic regulation consists in the knowledge of how to regulate the movement of vehicles and pedestrians so that they interfere with one another as little as possible and are enabled to go from point to point in the shortest time compatible with safety. Traffic regulations are divided into two parts—general and special. General highway traffic regulations are those which contain all things essential for the largest city and nothing superfluous for the smallest village. Such regulations should be standardized and their general use insisted upon throughout the whole country. Failure to realize this fact has always resulted in chaos and unnecessary loss of life.

In the scientific regulation of traffic, the first and most important step is the education of those to be regulated. If this principle is followed the work of the police becomes that of promoters and assistants rather than that of enforcers. Drivers and pedestrians, when they know their rights, become the real regulators, as they resent infraction by those few—a constantly diminishing number—attempting to over-ride the rights of others. This was once a theory, but to those familiar with the work it has long since proved to be a fact. If educational measures are relaxed traffic regulation goes backward.

It is essential that general traffic regulations be brief or they will not be read, clear or they will not be understood, reasonable or they cannot be enforced, uniform or they will result in confusion and danger. The first set of general highway traffic regulations was adopted in New York on Oct. 30, 1903. These have gone through many revisions. They were officially issued in Paris on July 10, 1912. On May 8, 1919, a new revision, most carefully prepared, was offered for standardization by the Council of National Defense through its highways transport committee. It is not probable that any other set will be compiled in the near future which will be better, although arrangements should be made so that, from time to time, suggestions for improvements can be considered.

TRAINED DIRECTION NECESSARY

The greatest trouble in traffic now is that many of the cities have delegated aldermen, commissioners or police officers to formulate traffic rules. These officials, with few exceptions, not content to profit by the experience of others, appear to have been actuated in their legislative efforts by a desire to originate and satisfy a pride of authorship. The result of their efforts has been that while they have plagiarized themselves by adopting everything of value in the New York regulations, these have been so distorted by rearrangement, rewording and by important omissions and unimportant additions that the patchwork thus produced has been confusing and much too long. The sets of regulations given to some of our cities contained over 6500 words, lacking both sequence and order and mixing up special regulations with general regulations.

Traffic regulations should never be in the form of an ordinance, but there should be an ordinance or some other law empowering the police departments to adopt the Council of National Defense code without change of any kind. This is the practical way of attaining uniformity so much to be desired because absolutely necessary for safety.

The Council of National Defense Code is printed in a 4 x 6-in. four-page folder in an especially approved form, containing marginal notes, and on a placard about 14 x 20 in. The folders should be kept for distribution at every police station and every driver should be obliged to pass an examination on the regulations and carry a copy with him when

driving. The placards should be displayed in public garages, stables, schools and station houses, and on standards in public places in order that pedestrians as well as drivers may have an opportunity to become familiar with them. Schools should instruct their pupils in the regulations and hold examinations and drills. We must rely on education of pedestrians through directions which appeal to common sense.

In trying to educate the public in general regulations we should eliminate all thought of special regulations, which must not under any circumstances be written into or form a part of the general regulations. In addition to the folders and placards of regulations cities should issue a pamphlet setting forth the special regulations, particularly those in regard to the approach to and departure from places of assembly, a list of one-way traffic streets, the method of obtaining licenses for driving, registration for vehicles, laws on equipment, etc, etc. This, however, is a separate and distinct thing and must not be confounded with general regulations.

Special Regulations

Special regulations are those which can be brought about by traffic guides consisting of lines, signs, standards, bumpers, dummy cops, semaphores, crowsnests, direction lights, etc., which can be extensively employed to guide the movements of both pedestrians and drivers.

Lines are of exceeding importance but not when unscientifically placed. Trained experts should be employed to lay them out.

Signs should denote their meaning, as far as practical, by their shape and color, different color combinations being used for different purposes. The best combination consists of vivid yellow letters, arrows or graphics on a black background. These should be used for moving vehicles. Secondary signs for stationery vehicles should have these colors reversed and tertiary signs, or those for the control of pedestrians, should have red letters, arrows or graphics on a white background.

Standards should never be joined by ropes, chains or pipes, as such practice is dangerous. They should be only sufficiently heavy to remain in place in a high wind. Their bases should be of special pattern to avoid rolling if knocked over. It is better to accentuate their visibility by placing them within painted lines or on a white disk. The bases and tops of portable standards should be painted bright red and the pipes with black and white bands from 8 to 12 in. wide, the top and bottom bands being white.

Bumpers should be kept painted white and should stand on a painted white disk so that they can be more easily seen.

"Dummy Cops," or posts designed as substitutes for traffic officers, first recommended in 1904, have multiplied so that there are now hundreds of thousands of various designs. They should be standardized as far as possible, painted in the same way as traffic standards, placed on white disks and effectively lighted at night. The dummy cop is far more effective and certainly more economical than anything else except an expert traffic officer and when such an officer is not available a dummy cop should be used.

Semaphores should be so constructed that their signs may be placed in a neutral position and then they may be left as dummy cops when there is no traffic officer on duty.

Crowsnests, such as used in Detroit, have proved of inestimable value and should be investigated carefully for use in every city.

Traffic Regulation Lights should be given further study in order to develop them for traffic purposes.

Role of Police in Traffic

The general and special duties of police in traffic regulation, uniform code of signals, traffic bureau, traffic court, etc., are treated at length in the text book entitled "The Science of Highway Traffic Regulation" [by W. P. Eno]. There are, however, certain points that should be insisted upon if we expect to reduce the loss of life and increase the saving of time.

The head of a police department should never attempt traffic regulation himself, but should delegate his powers to an officer not responsible to any one except the head of the department. He should have full authority and be held accountable for results only. Members of the traffic squad and other policemen when detailed on traffic duty should be under his control. He could have ready for use at all times a motor car in order that he may keep in close touch with his work.

The only way the world can make up for the cost of the war is by administering public as well as private enterprises in the future so that they may function without avoidable waste of life or money. In computing what traffic regulation can do, we are forced to adopt premises more or less conjectural though founded on experience. The figures are given for what they are worth.

Traffic Accident Losses

It is not possible to obtain an accurate count of lives lost by traffic accidents because many of the injured get away and die afterward, leaving no record. Estimates of the yearly loss of life in the United States [from traffic accidents] run from 10,000 to 57,473, the latter estimate being from an official report from Australia for the year 1920. This report states that during the nineteen months when the United States was in the war 48,000 men were killed in battle or died of wounds. That during the same nineteen months 91,000 were killed on the highways, 25,000 of these being children of school age. This is at the rate of 57,473 in a year, and at $10,000 per life—the amount the courts usually allow—it means a loss of $574,730,000. This sum, added to the financial loss through accidents to persons and property, the saving of time and money to people and the increased efficiency of vehicles through traffic regulation, indicate a loss of more than $3,000,000,000.

We may fairly suppose that if there were no traffic regulations twice that amount would be lost, and we may also assume that if traffic regulation was twice as good as it is we would save at least half of what is now lost or $1,500,000,000 per year.

These figures, inaccurate though they may be, since they are founded on assumed premises, I believe not to be exaggerated. It is now time for us to realize that the subject of traffic regulation must be taught in schools and in universities and the problems worked out by engineers of ability.

Nearly ten years ago, many of our city planners and other engineers began to take an interest in traffic regulation until now the subject may be regarded as a legitimate branch of civil engineering and as such it should be in the hands of men thoroughly trained for the purpose.

The great loss of life, time and money is largely due to the fact that practically every city has been allowed to make its own regulations, which are usually enforced by untrained traffic officers. Such methods are uneconomical and should be superseded by those of intelligence.

Propose Large Irrigation Project

Estimates recently prepared and submitted to Governor Hart of Washington and to members of the state reclamation board, show that costs of complete development of the proposed Horse Heaven Irrigation District, lying between the Columbia and lower Yakima rivers in south central Washington, will aggregate $31,522,644. The figures were compiled by a committee representing landowners in the district. Plans as outlined provide for a main canal system following the east side of the Klickitat canyon, concrete-lined throughout with riveted steel pipe for siphon crossings, and a system of reinforced-concrete distribution and lateral canals. Three reservoirs are contemplated. The first plan, however, is to use the natural flow without impounding. On this basis, the cost of the supply canals, intake, etc., is placed at $20,295,928, and the cost of the distribution system $3,678,000. Storage reservoirs to be built later are estimated to cost $4,595,152.

B. Welchii as Test for Safe Water and Cause of Water-Borne Diarrhea

Conclusion of Survey of Practice and Opinion—B. Welchii Technique at Montclair and Jersey City, N. J., and Method Used by D. D. Jackson for Detecting and Isolating B. Sporogenes and B. Welchii

A tabular summary of reports from 66 engineers, bacteriologists and others as to the use of the B. Welchii test for water and the liklihood that the germ causes intestinal disturbances appeared in Engineering News-Record *for June 2, page 929, with a number of supplementary statements. These statements are here concluded and some notes on laboratory technique are given. The numerals preceding the names of each correspondent refer to the table printed in our issue of June 2, 1921, pp. 330-331.*—EDITOR.

Further Supplementary Statements

31. *N. J. Howard, Toronto, Ont.*—In many laboratories there is a tendency to assume that a certain type of bacteria not killed by chlorine, and which produces abundant gas formation (usually after 48-hr. incubation), is B. Welchii. I think that in the great majority of such cases careful morphological and biological studies would show that the organism, while belonging to the anaerobic group, was not the typical B. Welchii.

The temperature of the water in Toronto during at least two months of the year is below 34 deg. F., yet an examination of the records covering a period of six years, and based upon the examination of six samples a day during that period, shows no evidence that chlorine is not absolutely effective in sterilizing the water. We are satisfied that, at least in Toronto, the efficiency of the sterilization process is not impaired by cold water conditions. This may not apply to other cities where the content of the water may be entirely different. We have no record showing the prevalence of seasonal epidemics in Toronto. A few years ago the accidental opening of a water valve controlled by an industrial concern resulted in some untreated water being drawn into the city mains. The area supplied by these mains was plotted out, and a house-to-house inspection made. It was expected that an epidemic would result, but, apart from some vomiting which affected children only, no ill effects were recorded.

Recently I published an article (*Canadian Engineer*, Jan. 20, 1921) on the prevalence of typhoid fever in Toronto during the summer months, when the raw water was most seriously polluted. It had been pointed out in England by Sir A. C. Houston, director of water examination, Metropolitan Water Board, that the prevalence of typhoid fever did not generally follow the worst water periods, as judged by chemical and bacterial tests. I showed that in Toronto, as in many American cities, typhoid fever cases did increase and follow the worst water periods of pollution, but that since bacterial examination of the water after filtration and chlorination clearly showed the water to be sterile, there was no indication that typhoid fever in Toronto was water borne.

Does Not Cause Epidemics

I know of very little evidence that B. Welchii causes gastro-enteritis epidemics. As isolated from water and sewage the germ is almost universally regarded as non-pathogenic in character. Possibly certain types of spore formers somewhat similar to B. Welchii, and which have been frequently isolated from water and milk supplies, are capable of causing epidemics of diarrhea. But in these cases the organism would have to be present in considerable numbers before an epidemic would result, and it is hard to see how this could happen in a water that had been efficiently chlorinated. Even if the spores resisted chlorination, it is probable that they would be weakened and much less liable to be of a virulent nature.

Where it is claimed that B. Welchii is the actual cause of an epidemic, it should not be difficult to establish the fact. Bacterial examination of the feces of those affected should show the presence of B. Welchii in enormous numbers. The bacillus is normally present in the intestinal flora, but in an epidemic, if it was the direct cause, it would predominate.

If it can be clearly shown that B. Welchii is direct cause of intestinal disturbances a very difficult controversy will arise, involving a radical change in present ideas of the efficacy of chlorine in eliminating water-borne epidemics. The results of effective chlorination have been so conclusive that one hesitates to accept any such new theories, because, if the contention were a sound one, epidemics would be of frequent occurrence in almost all American cities.

Classifying Bacteria

During the war much work was carried out by American and British authorities on the classification and study of anaerobic bacteria. Several types of these anaerobes have been isolated from water and sewage, including B. Welchii, B. Aerogenes Capsulatus, B. Sporogenes, B. Enteritidis Sporogenes, and at least ten others not classified. It is probable that some of these are one and and the same bacillus, the morphology having been slightly altered by the cultural methods used. The typical B. Welchii does not form spores, whereas both B. Aerogenes Capsulatus and B. Enteritidis Sporogenes of Klein are spore formers. There is, however, an atypical variety of B. Welchii which forms spores. This would seem to have a distinct bearing upon the efficacy of chlorine, and upon the powers of the spore formers to resist effective chlorination. Some years ago when Klein isolated the B. Enteritidis Sporogenes, following an epidemic of diarrhea in St. Bartholomew's Hospital, London, England, he found the stools of the sixty cases involved to be literally swarming with the bacilli, but the epidemic was traced to the milk supply.

The B. Welchii test is still made in England but is known as the B. Enteritidis Sporogenes test. Houston in his "Studies in Water Supply" (London, 1913, pp. 157-8) says in part:

> The milk tubes are examined and those showing the B. Enteritidis Sporogenes phenomenon (gas formation, separation of the whey from the casein with precipitation of the latter) are registered as positive results. It may be objected that a variety of microbes may produce these changes, and the writer has always frankly admitted that he regards the test primarily as a test, and not necessarily as proving the presence of a particular microbe, and that microbe alone.
>
> The above changes in milk culture were described by Klein as characteristically typical of the growth of B. Enteritidis Sporogenes, and so it is both complimentary and convenient to retain the name, although the word *test* should be added as signifying that, in recording a positive result, one is not necessarily committed to the view that the characteristic changes are produced solely by one microbe, and that the one described by Klein. The practically important point is that sewages commonly yield a positive result with 0.001 c.c. and pure water a negative result with 10 c.c. or even more.

32. *S. C. Prescott, Cambridge, Mass.*—Doubtless the number of B. Welchii in water indicates to some extent the degree of pollution. Because B. Welchii is a spore former it may indicate remote pollution, but if it occurs with even small numbers of B. Coli it confirms in a striking way the evidence of recent pollution supplied by the colon finding. Tests for B. Welchii are very useful in water examination. Occurrence of the germ should not be regarded as indicating merely a very remote degree of pollution. The B. Welchii test should not be considered as a substitute for the B. Coli test, but as supplementary.

I am strongly of the opinion that heavy infection of water with B. Welchii may give more or less serious intestinal troubles, such as we had in Cambridge for a day or two in 1920. [See also report from Prof. M. C. Whipple.—EDITOR.] Following the break-up of snow and ice, and probably as the result of the inrush of surface water, there was perhaps a week during which the consumers of Cambridge water were quite markedly infected with a diarrhea. Apparently with the settling of the water [in the storage

reservoirs.—EDITOR.] this disappeared. When we first made examinations we were able to demonstrate organisms of both the colon and Welchii types. A temporary chlorination plant was established. The water quickly resumed its normal condition and there was no further trouble. I do not regard the Cambridge water as entirely unpolluted as it is possible to get from time to time a colon reaction and also B. Welchii. That it is not a grossly polluted water is shown from the drop in the typhoid rate. [Cambridge for years past has had a very low typhoid rate.—EDITOR.]

Probably waters generally free from pollution are quite likely to cause intestinal disturbances when some gross contamination from surface wash or other material takes place, whereas consumers of constantly polluted water acquire a sort of immunity to the casual organisms. We have no statistical evidence of this but some practical evidence seems to be given by cities with badly polluted water supplies—for example, by Pittsburgh before filtration. We are still quite a bit in the dark as to the significance of B. Welchii.

34. *R. S. Weston, Boston.*—In 1899 I studied the B. Welchii organism (which is the same as the B. Enteritidis Sporogenes of Gaertner and Klein, described by the latter in the Report of the Medical Officer to the English Local Government Board, 1901-2). I did enough work on B. Welchii to find it in many waters, and to prove that it was as prevalent here as in England. Not being a real bacteriologist, I dropped the matter, particularly as most of my bacteriological friends were not in favor of searching for the organism in the ordinary routine and also because it was then necessary to inoculate guinea pigs with the organism in order to demonstrate its presence. Since then, the methods have been improved, and I believe that the organism should be looked for in all our water supplies, particularly those supplying communities where intestinal disturbances are prevalent.

I do not believe that the ordinary dose of chlorine, say 0.5 p.p.m., affects the spores of B. Welchii, although Houston states that a larger percentage of the latter organism than of B. Coli is removed by filtration. This he believes is because of the greater motility of the B. Coli and the larger diameter of the spores of B. Welchii. Because both these organisms are intestinal forms and are abundant in sewage and silt, and also because B. Welchii is very prevalent in richly manured soil, there is no reason why the organisms which are most easy to detect should be selected for study and the search for B. Welchii neglected, particularly in waters which have been treated with chlorine in doses insufficient to kill the spores of the latter. Houston and others have advocated the super-chlorination of water (followed by the use of an antichlor) to make sure that not only B. Coli is killed but also the spores of B. Welchii.

THE CAMBRIDGE OUTBREAK

35. *M. C. Whipple, Cambridge, Mass.*—The Cambridge outbreak [mentioned in the foregoing letter by Prof. Prescott.—EDITOR], was very elusive and in my mind never pinned down to facts, chiefly on account of the lack of analytical data. An outbreak of diarrhea occurred about the middle of March, 1920, following a heavy thaw. For years we had been making analyses of Cambridge water practically every week and sometimes oftener. I had expected that the bacterial content of the water would increase about this time, and it did, but the analyses I had and any others I saw did not show conditions to be as bad as they had been in some previous years—that is, the bacterial content was not as high nor were B. Coli as numerous as at some other times.

Unfortunately, there were no analyses by any laboratory for 3 or 4 days before and after the date set by the state epidemiologist for the onset of the disturbance. The outbreak lasted only 2 or 3 days. The state epidemiologist intimated that there might have been about 1,000 cases but the true number is uncertain as all the cases were mild, many not requiring a doctor. The public was unduly freightened by a warning to boil the water, this being sent out after the bulk of the cases had occurred. Chlorination has been quite regularly practiced for some months past. [Bids for filters were requested in April, 1921.—EDITOR.]

I made an extensive study of the Fresh Pond reservoir as soon as the trouble started and also of the watershed streams. The results were not as bad as expected, probably due to dilution by the large run-off from melting snow. If the main reservoir, Fresh Pond, had been polluted to any great extent the pollution would have manifested itself for a considerable time. This reservoir holds 1,400,000,000 gal. and the water is pumped from it to the distributing reservoir. On the whole, the case against the water supply was not a strong one, but certain epidemiological evidence pointed to it, such as the fact that the majority of cases had nothing in common but the water supply. If pollution occurred, it was for a very short time only and escaped notice in routine analyses.

We have not regularly made tests for B. Welchii. In fact, I have never been able to appreciate the significance of this test. I fail to see what it indicates that B. Coli does not, unless the fact that B. Welchii may form spores points to pollution far in the past. This does not seem to be a great desideratum in view of the fact that all of the intestinal pathogens succumb, so far as we know, in water before B. Coli succumbs. Furthermore, B. Welchii is a common inhabitant of the soil.

I think we have all felt that there may be disturbances caused by water which we have heretofore disregarded because of the greater importance of typhoid. There is a question whether these relatively slight disturbances, if due at all to water, are the result of a mechanical or chemical irritation or are caused by bacterial infection.

EXPERIENCE AT SACRAMENTO

36. *Frank Bachman, New York City.*—B. Welchii and other allied lactose-splitting organisms have interested me for a number of years, especially since the advent of chlorination. My best opportunity to study B. Welchii was at Sacramento in 1916. The city was furnishing dirty river water, treated with liquid chlorine only. Early in December, 1916, an agitation against chlorination arose due to the disagreeable tastes. The taste, chlorine-like, was very marked for a period of over a year prior to this time. Among the many theories advanced as to the cause of the tastes were: chlorination, microscopic organisms, and drainage from rice fields some distance above the town. The city chemist claimed that the taste was due to chlorine—or that at least it was similar to chlorine—but his tests for free chlorine in the tap water were negative. The rice fields had been drained sometime previous, so that source was more or less eliminated. Microörganisms were few in number in the raw water, which also precluded the possibility of tastes from this source.

The local health board decided to cut off the chlorine supply for several days and see if the tastes disappeared (a rather criminal procedure). The State Board of Health asked for an immediate hearing at which it was decided to put the chlorine plant into the state's hands.

As chemist of the State Board of Health, I was immediately detailed to Sacramento. I found that the city dosing with chlorine at the rate of 4.2 lb. p.m.g. or about 0.5 p.p.m. Studies showed that 1 lb. eliminated tastes and that no B. Coli were found in the treated water, while 2.2 lb. gave a slight taste. It was decided to use 1.8 lb. p.m.g. to keep below the taste point and still give a high factor of safety. The city has been using this dose ever since with practically no complaints from tastes and no cases of typhoid or other intestinal diseases attributable to the city water.

The city laboratory was using lactose bile as a presumptive test. (Standard Methods, A. P. H. A., of that time). Its desire was to eliminate gas-producing organisms completely in 50 c.c.; consequently the high chlorine dosage. I had it changed over to lactose broth and confirmed all gas formers on endo medium. The city chemist took some exceptions to this procedure, as it was not standard, but he later found that the Standard Methods of 1917 were practically the same as I had outlined.

An intensive study was made to determine the organisms producing gas in lactose bile and resisting chlorintion. I isolated B. Welchii from seven different tap samples around town when the water had a distinct chlorine-like taste.

My identifications were verified by bacteriologists at the University of California. In lactose broth, little or no gas was formed by B. Welchii in 24 hr., but considerable in 48 hr., while in lactose bile much gas was found in 24 hr. I explain this as follows: B. Welchii will develop immediately in lactose bile or milk because these media are favorable to this organism; whereas lactose broth is not so favorable and the organism will not propogate until the medium is strictly anaerobic. It is well known that lactose broth contains dissolved oxygen, especially after it has stood in the ice box for days. At Sacramento, when using lactose broth, a prolific growth of organisms took place in the first 20 hr., which consumed the oxygen, after which B. Welchii took a start and in 48 hr. large quantities of gas were noted.

The taste in the Scramento River supply when using large quantities of chlorine was due to chloramine compounds (NH_2CL) or combinations of chlorine and organic matter. The bacteria being vegetative unite with the chlorine first, as their cells are easily oxidized and unstable. This seems reasonable, as B. Coli elimination can be accomplished without taste if the chlorine is properly applied.

The literature indicates that B. Welchii are widely distributed. They are in fact more widely distributed than B. Coli because of their resistance, and of their ability to change from the vegetative form to the spore or resting stage. In the Sacramento River water, B. Coli were present in the raw water in from 10 to 1,000 per c.c. while B. Welchii were found in much smaller numbers, about 1 to 5 per 50 c.c. Studies on the Potomac have shown that a lower ratio of B. Welchii to B. Coli exists near the source of pollution and a higher ratio further down stream. [See summary by W. F. Wells.—EDITOR.] This means that as the river purifies itself the B. Coli die off, leaving the B. Welchii in the same or somewhat reduced numbers. B. Welchii are commonly found in milk. Much difficulty has been experienced in the pasteurization of milk, due to the resistance of B. Welchii. Many pasteurization plants have been condemned because the laboratories have found gas formers in the pasteurized product. The literature is filled with epidemics attributed to B. Welchii. The best publication on this subject is a monograph by Dr. J. P. Simonds.

INTEREST LARGELY HISTORICAL

The fact that I found B. Welchii in the Sacramento River water gave the city officials some work and they claimed that this organism should be eliminated. It has not been eliminated from the supply in the past four years and no epidemics have occurred. Dr. Simonds and Dr. Fisher, the latter a well known bacteriologist and pathologist of the North of California Medical School, both wrote letters to me at the time stating that in their judgment B. Welchii as found in water supplies is non-pathogenic.

It has always seemed to me that B. Welchii has more of a historical than other interest in determining the character of a water supply. Also, that if B. Coli is eliminated from the supply, bacterial purity is established. The differentiation of the various groups of B. Coli into grain, human, etc., is a rather risky procedure, especially if the purity is to be based on the source of the B. Coli. One state, a few years ago, held that a water supply may contain B. Coli other than the fecal type. With the present knowledge of water purification, this stand is criminal, as the differentiation of B. Coli into the various groups is not sufficiently substantiated. My opinion is that if we eliminate the vegetative forms (B. Coli, etc.) we eliminate those organisms apt to give intestinal troubles. The epidemics from B. Welchii have been traced to milk in which it is known that this organism will multiply very readily, while it is present in water usually in the spore state.

37. *W. S. Coulter, New York City.*—My experience has been that water containing B. Welchii may be successfully disinfected with liquid chlorine. As an instance, I may cite the case of Talladega College, Ala., where I installed liquid chlorine apparatus, following a sanitary survey in 1915. This institution secured its water from the City of Talladega, from wells in fissured limestone. Previously, the city supply had been secured from so-called springs, which were in fact outlets from cavities in the limestone, which probably received pollution from the surface. Examinations of the city supply and of water from an old well on the college grounds showed B. Welchii frequently in 1 c.c. and occasionally in 0.1 c.c.

Following the disinfection of the college supply (0.3 p.p.m. of chlorine) an immediate improvement in the health of the students was noted. Soon after, Talladega put in a disinfecting plant for its entire supply. Since then, the formerly recurring epidemics of dysentery, typhoid and paratyphoid in the city and at the college have entirely ceased. Here was a sporogenes-bearing water, furnished to a community in which dysentery was common and typhoid outbreaks frequent, the disinfection of which brought about the practical disappearance of these diseases.

INFERIOR AS POLLUTION INDICATOR

While B. Welchii is frequently found in the discharge of dysentery patients, I do not understand that it has yet been demonstrated that it causes the disease rather than a type of organism which finds the conditions established by dysentery congenial to its growth. B. Welchii may be considered as an indicator of pollution, but is inferior to B. Coli, although in certain cases a knowledge of its presence may be useful. It is difficult to identify and isolate from a water supply a specific bacterium causing dysentery in a given instance. That such bacteria are intestinal in type may be accepted and, if B. Coli is absent, it may be reasonably assumed that other intestinal bacteria are likewise missing. A predominating indicator, such as B. Coli, seems to me to afford a most reliable means for presumption. That resistant bacteria remaining after disinfection are peculiarly spore formers, such as B. Welchii, or that spore formers constitute an abnormal proportion of the type surviving, has not, I think, been demonstrated.

Bacterial examinations are suggestive rather than conclusive, and I would not care to proceed very far in any case on bacterial information alone. Should it, however, be conclusively demonstrated that spore-forming bacteria causing dysentery or other diseases often survive present methods of disinfection in active condition, it would indeed be unpleasant news to the sanitary engineer.

41. *Dr. H. D. Pease, New York City.*—While we have not been systematically employing any particular method of testing for B. Welchii in our investigations of water, milk and other food, we have made fairly extensive observations with respect to the presence of spore formers and products of these types. We have probably made more observations of this sort in connection with shellfish studies than in the case of any other food examined. As shellfish problems are more or less directly related to sewage pollution of tidal waters, our observations are perhaps pertinent.

Where tidal waters receive much pollution and such pollution is not carried by the tidal current very rapidly in the direction of the oyster bed, and especially where there are opportunities for sedimentation and preliminary purification, we have noticed a very decided tendency for our analyses of oysters during the non-hibernating period of the year to show very considerable numbers of B. Welchii, although B. Coli may not be in excess of the numbers permitted by practically all of the health supervisory organizations having charge of oyster inspections and examinations. Undoubtedly, many oysters of this sort have been consumed, especially in September, October and early November. If this has caused intestinal disturbances, the numbers of cases do not appear to have been notable. It is well known that in any substantial instances where oysters have been responsible for the development of outbreaks of typhoid, the onset of this disease has been preceded by many cases of diarrhea and other intestinal derangements among those who have consumed the oysters.

The relation of B. Welchii to milk supplies has received considerable attention by English bacteriologists under the name B. Sporogenes. The subject has been extensively dealt with by Dr. W. C. Savage in his book, "Milk and the Public Health." The whole question of finding spore-forming bacteria in milk supplies requires considerable investigation. I am inclined to believe that the findings will vary in differ-

ent localities, not so much on account of the possibilities of differences in the original contamination of the milk, as because of the varied systems of heating the milk as it passes from the farm to the consumer. One has only to stop to think that it is far easier to destroy vegetative forms of bacteria than it is the spores to realize that whenever spores gaining access to milk have a chance to develop into the vegetative form, they are much more easily destroyed by heating processes than they are if they have never had a chance to grow out of the spore stage. It is therefore more common to find spore-forming bacteria in very excellent milk supplies than in the ordinary run of pasteurized Grade B milk. One would hesitate to suggest that all milk should be somewhat incubated before it is pasteurized—so as to destroy spore-forming bacteria—and yet as a practical proposition, that is what actually happens in the very considerable amount of the common Grade B milk supplied to the public after pasteurization.

Disease-Bearing Evidence Not Satisfactory

42. *Dr. W. W. Ford, Baltimore.*—B. Welchii is a normal inhabitant of the intestinal tract of man and of the domestic animals and is present in their dejecta. A claim has been made that an increase in the number of B. Welchii occurs in certain diseases, as in pernicious anemia and in summer diarrhea of children. There is no satisfactory or convincing evidence that this is so.

The spores of B. Welchii are widely distributed in nature, having been isolated from the dust of rooms, street dust and from a great variety of soil. They are constantly present in natural waters, both polluted and unpolluted, and their presence in water has absolutely no sanitary significance. I pass a water as satisfactory which is free from B. Coli, despite the fact that the water contains B. Welchii. I know of no diseases in this part of the country which can be traced to the entrance of spores into the intestinal tract from drinking water. It is theoretically possible that both B. Coli and the spores of B. Welchii would go through a filter and that B. Coli would be destroyed by chlorination while the spores of B. Welchii would resist chlorination, but one ought not to draw conclusions from hypothetical conditions of this character.

A short paper "On the Occurrence of B. Welchii (B. Aerogenes Capsulatus) in the Dejecta of Sewage," by J. H. M. Knox, Jr., and W. W. Ford of Johns Hopkins University (the Johns Hopkins Hospital Bulletin, January, 1915) contains this conclusion:

> It is evident from the results of this inquiry that B. Aerogenes Capsulatus must be regarded as a normal and constant inhabitant of the intestinal tract in children except in breast-fed infants . . . attaching pathological significance to the presence of this species in the intestines can, therefore, properly be made only when evidence can also be adduced to show its excessive development. In view of the fact that in several of our normal cases the majority of the milk tubes gave positive results, we are of the opinion that satisfactory evidence of an abnormal proliferation of this species in pathological cases has not thus far been brought.

46. *M. F. Stein, Chicago.*—The definition of B. Welchii is somewhat dependent upon the cultural characteristic used for its identification, as there are a number of more or less closely allied types. Since B. Welchii is found not only in the human intestines but also in those of animals and in richly fertilized soils, and is a spore-former capable of resisting adverse conditions, it would not seem to be as good an indicator of recent pollution as B. Coli, which is more akin to the serious water-borne diseases. However, it would be valuable to study its frequency in filtered and chlorinated water, as this would shed light on the efficiency of chlorination relative to spore formers.

In view of the many strains of lactose fermenters which have been traced out by bacteriologists, and the numerous complicated (sometimes contradictory) cultural tests which have been advocated recently, I favor a simple fermentation test which will include all suspicious bacteria, even though it may also include many harmless forms; then, for raw water, prove such suspicions by a thorough field survey rather than by more laboratory work, which is less direct and less conclusive. In the case of filtered supplies, I am inclined to consider the bacterial finding more of an indication of filter efficiency, and to give less attention to the type of organism found, since the action of filters is not preferential. By sanitary control of the watershed so as to maintain the raw water in a condition such as can be made safe by filtration, and by maintaining good filter efficiency, a safe filtered water is assured. There are of course many water problems where more elaborate bacteria procedure is justified.

47. *Max Levine, Ames, Iowa.*—I do not use the B. Welchii test as a routine matter, but where the positive presumptive tube shows no growth on the confirmatory plate, I note that the gas production was probably due to an anaerobic spore-former. I believe that the use of B. Welchii as an index of the probable presence of such intestinal disease organisms as typhoid and dysentery is without adequate foundation, for there is no question at all but that a stored or chlorinated water may contain spore-forming anerobes long after all typhoid and dysentery bacilli have been destroyed by the treatment. If, however, B. Welchii is to be regarded as a specific cause of infection, there may be some justification for such a procedure. This organism has been considered by some bacteriologists as sometimes responsible for diarrhea. Some strains produce an irritation in the intestinal tract, supposedly due to the production of butyric acid, but members of the Welchii group are so frequently encountered in milk that it would seem that the occasional organism, which may be present in water, would be insignificant. If further observations indicate that B. Welchii is really responsible for water-borne diseases, it would be necessary to determine the characteristics of the responsible strain. The term B. Welchii is used by water bacteriologists in a very loose sense to include all spore-forming anerobic organisms capable of fermenting lactose. Most of these forms are non-pathogenic, so that I question the condemnation of water merely on finding spore-forming anerobes. It will be necessary to determine the particular species of anaerobe present.

Laboratory Technique

D. D. Jackson, Department of Chemical Engineering, Columbia University, New York City.—Most water supplies are now treated with chlorine so that the bacterial content is greatly reduced and B. Coli and nonspore-forming disease germs practically eliminated. The amount of sterilizing agent used is not great enough, however, to kill the spore forming organisms[1] and an amount necessary to kill spores would be beyond the practical limit for drinking water purposes, although such amounts may be used in the treatment of sewage or factory waste[2]. The group of anaerobic spore-forming gas-producing organisms are known to be associated with certain diarrheal disturbances. Of this group, B. Sporogenes and B. Welchii are the most common. The pathagenicity of B. Sporogenes having been established,[3,4] and its presence in feces and sewage demonstrated by Klein, Houston[5] and others, it is important that a simple and rapid method should be employed for the determination of its presence in public water and milk supplies.

The usual procedure is to heat various dilutions of the sample in sterile milk to 80 deg. C. for ten minutes, and incubate anaerobically for from two to three days. After this time, if the bacterium is present in the spore state in the dilutions used, there will be a strong acidity produced, and a complete separation of the curd and whey with a strong odor of butyric acid.

This test is, however, somewhat indefinite, as there are several other spore-forming bacteria which give this reaction. It should also be noted that the method described considers specifically the spore state of the bacillus and would fail to detect it if it were present only in the vegetative condition. It is also true that exposure to such a high temperature might kill the spores, if they are somewhat attenuated. It is probable that this condition may exist if they have been in the water any length of time.

These sources of error have been eliminated by a method which also serves to isolate B. Welchii,[6] a spore and gas forming organism equally prevalent in polluted water and which has been found by the author on several occasions in abnormal numbers in the feces of children suffering from

| SPECIES. | FERMENTATION | | |

Dr. George E. McLaughlin, Sanitary Adviser and Bacteriologist, Bureau of Water, Jersey City. The method used in Jersey City water-works laboratory in testing for B. Welchii follows: A total of 14 fermentation tubes, half containing lactose bile media and half lactose broth media are inoculated with the water sample. In each set of seven there are one 0.1 c.c., one 1 c.c. and five 10 c.c. tubes, making a total of 102.2 c.c. of water for both sets. Any tubes of either media showing gas during 72 hr. incubation at 38 deg. C. are examined for B. Welchii, which as a rule produce a high percentage of gas—80 to 100 per cent and usually the latter within 36 hours. Five steps follow:

1. With a small pipette, 2 c.c. is drawn out from the bottom of the tube and inoculated 1 c.c. into a culture tube containing 10 c.c. Krumwiede triple sugar agar with Andrade indicator, and 1 c.c. into a culture tube containing 10 c.c. of whole milk, both these tubes having been very recently boiled to drive off contained oxygen.

2. Both these tubes are then put in a water bath and kept at a temperature of 80 deg. C. for 15 minutes, to kill any B. Coli type of organisms that might have been present.

3. The two tubes are then placed in a Novy jar and the oxygen exhausted, allowing the tubes to cool before putting in the incubator.

4. The tubes are incubated for 24 to 48 hr. at 38 deg. C.

5. If the B. Welchii type of bacteria is present a stormy fermentation takes place, blowing the agar media to pieces with a beautiful pink coloration of the same; and in the milk tubes showing gas formation and separation of the whey from the casein, with precipitation of the latter.

It may be objected that a variety of microbes may produce these changes, but I frankly admit that I regard this procedure primarily as a test, and not necessarily as proving the presence of any particular microbe, and that microbe alone.

I consider step 5 important, for I have obtained this phenomenon with B. Coli types when not using the heat to kill this group of organisms.

H. B. Larner, Health Officer, Montclair, N. J.—In making the B. Welchii test at the Montclair Board of Health laboratory 10 c.c. samples of water are inoculated into each of five fermentation tubes containing lactose peptone broth. The tubes are incubated at 37.5 deg. C. for 72 hours. From tubes showing the production of gas in amounts varying from 40 to 100 per cent, and having a typical butyric acid odor, a loopful of media is placed in a petri dish and an endo plate poured (*not smeared*) about ¼ in. thick. The plates are incubated at 37.5 deg. C. for 24 hours. A typical red colony showing a bubble of gas at the bottom of the dish is then fished and inoculated into a tube containing 5 c.c. of sterile whole milk which has been recently boiled to drive off absorbed oxygen. Hot sterile paraffin is next poured on top of the milk so that when cool it forms a solid air-tight seal about ½ in. thick with the production of anaerobic conditions. The tube is then incubated 24 hours at 37.5 deg. C. Coagulation of milk with typical stormy fermentation and gas production, which forces the paraffin seal to the top of the tube, is taken as confirmatory evidence of the presence of B. Welchii.

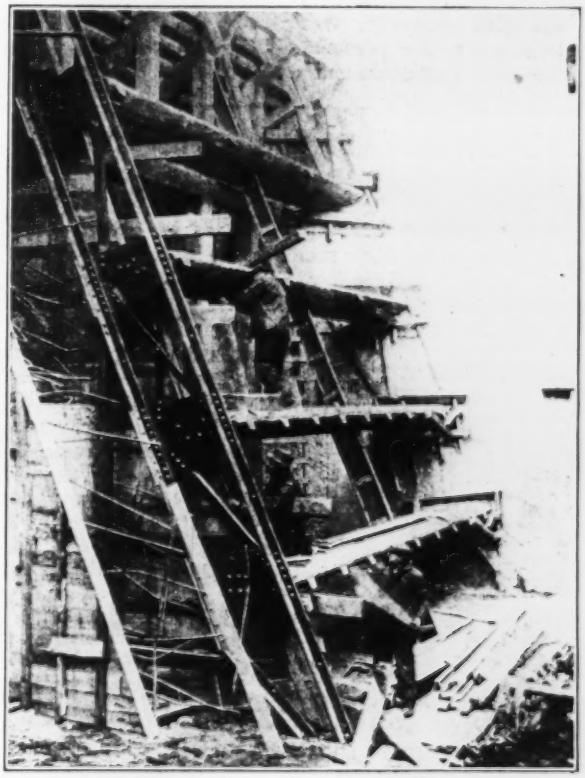
Three States Authorize City-Manager Plan

Legislation enacted in March of this year, according to a circular issued by the National Municipal League, makes it possible for any and all cities in Indiana and Wyoming to adopt the city manager plan, while in Missouri the option was granted to third-class cities. The city manager act for Indiana was largely drafted by A. R. Hatton, staff consultant for the National Municipal League, and the Wyoming bill was submitted to representatives of the League for criticism and suggestions. Up to April 13, 19 Indiana cities had communicated with the League regarding the adoption of the city-manager plan under the new statute. The secretary of the National Municipal League is H. W. Dodds, 261 Broadway, New York City.

Steel Trash Racks Coated with Concrete Placed by Cement Gun

IN ORDER to protect the steel frame trash racks at its hydro-electric power station at Vernon, Vt., and to provide as smooth a waterway as possible, the New England Power Co. has encased the steel in concrete placed with the cement gun. The main girders of the racks were first coated with the gunite and then erected in place and the ties made with further gunite.

The extension to the plant where these improvements were made contains two water wheels, each of which has a water capacity of 1,800 ft. per sec. This water passes



GUNITED BEAMS BEING ERECTED IN RACK

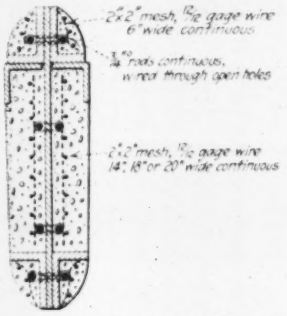
through racks which cover an opening in front of each unit 45 ft. wide and 26 ft. high. The racks are supported by four intermediate lines of built-up structural steel girders which in turn are supported at each side and at the center of each unit opening. Thus there are 16 of these girders, part of them 21 ft. 6 in. long and part 25 ft. 9 in. long, varying in width from 28 in. to 34 in.

Before erecting these supporting girders in place, the steel, which was never painted, was thoroughly cleaned and wire mesh fastened securely to the girders on all surfaces and spaced in general about ¾ in. from the surface of the beam. Each beam was then laid horizontally and gunite applied to bring the section of the final beam out to a uniform line. After the gunite had set, the beam was turned over and the other side completed. The beams were then handled to place by derrick.

After bolted connections had been made and small vertical interconnecting members placed, the beams were concreted in at the ends and the middle piers

respectively and connection pockets and the small steel members gunited in place.

The plant extension was designed and the work carried out by the Power Construction Co. of Worcester, Mass. The particular feature of the work here described was also designed by the same company. All of the work of guniting the beams and ties, however, was done under the personal supervision of a Cement Gun Company expert.


2"x2" mesh, 12g gage wire 6" wide continuous
¾" rods continuous, wired through open holes
2"x2" mesh, 12g gage wire 14", 18" or 20" wide continuous

SECTION THROUGH GIRDER SHOWING GUNITE COVER

Diagram for Plotting Vertical Curves

By Harold T. Avery
San Luis Obispo, Cal.

THE plotting of vertical curves on grade profiles, which is usually a minor detail in the drafting work for railway and highway projects, is becoming of greater importance with the development of highway engineering, for almost invariably a highway or road profile is made up of steeper and shorter grades than a railway profile, thus increasing the frequency and curvature of the vertical curves. Although a vertical curve plotted on any of the ordinary profile scales is a portion of an elongated parabola or ellipse, that portion so nearly approximates a circular arc that in most cases it may be plotted as such without appreciable error. The rapid and accurate plotting then depends upon the easy determination of the proper radius, facilitated by a set of even-radius curves, or even-degree curves.

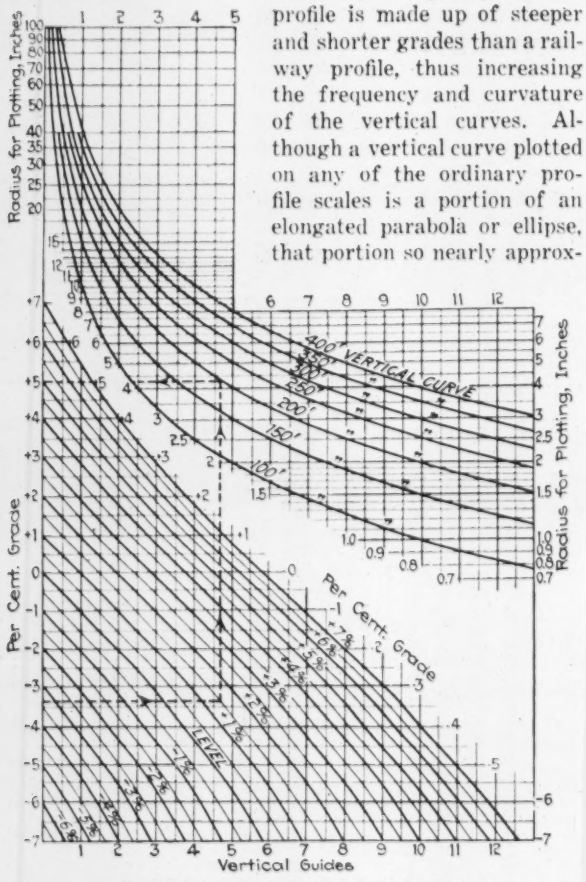


DIAGRAM FOR VERTICAL CURVES

If the intersecting grades, as plotted, do not make more than about 20 deg. with the horizontal, and if the maximum length of curve, as plotted, is in the neighborhood of four inches, the proper radius may be determined conveniently as a function of the per cent change in grade and the length of curve, by formulas 1 and 2. The word "scale" in the formula means the number of field or actual units per unit of length on the plot, as 10 when the scale of 1-in. equal 10 ft. is used. These formulas will give the radius in inches, if the length of curve is given in feet and the scales in feet per inch.

$$\text{Radius} = C \times \frac{\text{Length of curve}}{\text{Per cent change in grade}} \quad (1)$$

$$C = \frac{100 \times \text{vertical scale}}{(\text{horizontal scale})^2} \quad (2)$$

When the length of curve as plotted is much over four inches, or especially when the intersecting grades, as plotted, make over 20 degrees with the horizontal, this formula cannot be depended upon to give results sufficiently close for plotting. In fact, using the scale of 1 in. = 100 ft. horizontally, and 1 in. = 10 ft. vertically, which scales are ordinarily used on federal-aid road projects, the error in the case of grades over 5 per cent becomes appreciable. To meet this condition, the writer has devised the accompanying diagram, in which the intersecting grade per cents are used directly in determining the radius, instead of using merely the per cent change in grade. The radius thus determined is that of the circular arc which when placed tangent to the intersecting grade lines will pass through the proper point at the middle of the curve.

In the diagram the horizontal lines representing the radii for plotting are so drawn as to make one line correspond to each curve of the ordinary set of even-radius curves. If an office is equipped with even-degree instead of even-radius curves, they may be used by re-labeling these lines accordingly. If an office ordinarily makes its profiles on other than the scales mentioned above, the diagram may be adapted to the desired set of scales by re-labeling the grade per cent curves, using the formula (3), and re-labeling the curves for the various lengths of vertical curves, with new lengths determined by formula (4).

$$\text{New grade per cent} = \frac{10 \times \text{vertical scale}}{\text{horizontal scale}} \times \text{old grade per cent} \quad (3)$$

$$\text{New length} = \frac{\text{Horizontal scale}}{100} \times \text{old length} \quad (4)$$

With the diagram thus adjusted to the scales and equipment of the particular office, all vertical curves may be plotted quickly with ease and accuracy.

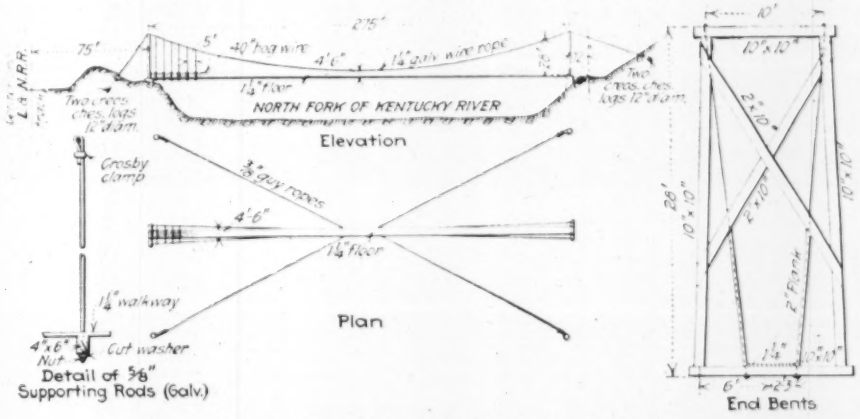
In using the diagram, from the intersection of horizontal and diagonal lines representing the grade per cent of two intersecting grades, follow vertically upward to the intersection with line representing required length of vertical curve. The horizontal line at this point gives the desired radius. For example, a 200-ft. vertical curve between grades of — 3.37 and + 1.50 per cent takes a 4¼-in. radius. For vertical curves of length not shown, read the 100-ft. curve line and multiply by length in stations. For scales other than those shown in the diagram multiply both grade per cents by horizontal scale ÷ (10 × vertical scale) and multiply required length of vertical curve by 100 ÷ horizontal scale, using the values thus obtained in following the diagram.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

A Suspension Footbridge Worth Study

Sir—Some of your readers who are fond of calculating suspension bridges may be interested in attached drawing of a suspension foot bridge which was constructed in Kentucky during the year 1920. The attached drawing was traced from the engineer's drawing, by which the bridge was constructed. I am told that the bridge has had as many as 50 people on it at one time. Of course, neither the writer nor the company with which he is connected had anything to do with its construction.



A NEW KENTUCKY SUSPENSION BRIDGE

C. H. BLACKMAN,
Principal Asst. Engineer Louisville & Nashville R.R. Co.
Louisville, Ky., May 16.

Non-Ferrous Slag in Concrete

Sir—I observe that an editorial note at the head of the article, *Engineering News-Record*, May 19, 1921, p. 840, describing the Bingaman St. viaduct, Reading, Pa., built of slag concrete, says that, "Contractors will observe the evidence that slag concrete is more workable than concrete with a stone aggregate; there is less weight to be handled per unit volume of concrete and the mixture flows more readily through chutes and fills the forms with less labor":

Evidently the slag used is the product of the blast furnace in smelting iron ore. The slag produced in the West in the smelting of gold, silver, copper and lead is heavier than any stone aggregate; breaks into exceedingly sharp and angular pieces, and when used in concrete produces a mixture of low flowability, comparatively difficult to handle. On account of its weight and fire-resisting quality this slag is especially suitable for retaining walls, and for concrete subjected to the combination of high temperature and water such as occur in railway ash pits, for example, but on account of its greater weight it is not suitable as the aggregate in reinforced-concrete column, beam and slab work. It would place a sharp limitation on the use of reinforced concrete in high building construction.

This Western slag makes, in my opinion, a ballast for railroad track better than any rock ballast. It exists in vast quantities at the copper smelters and is extensively used as railway ballast. It weighs about 3,400 lb. per cu.yd. when broken up to ballast size as against about 2,400 lb. per cu.yd. for ordinary rock.

J. L. CAMPBELL,
Chief Engineer, El Paso & Southwestern System.
El Paso, Tex., May 28.

Mixed Construction

Sir—I note Mr. Hagarty's letter in your issue of May 12, p. 825, entitled "Concrete Building Failure Shows Monolithic Nature of Frame," in which he makes reference to the reconstruction work on the United States National Bank Building in Denver, Col., described by myself in your issue of April 7.

The incident which Mr. Hagarty describes of two interior columns in the ground story of a seven-story reinforced-concrete building failing without cracking the slabs and beams which were supported by these two columns is very remarkable. I assume that the failure was "incipient" and not complete, and that the columns were removed and replaced with structural steel columns because they showed signs of failing. The query at once arises why these two columns were not replaced with reinforced concrete, as could have been easily done. If we are to understand that the two columns actually collapsed so that they no longer carried any portion of the load of the floors above, then indeed it is very remarkable that the floors which had been supported by these two columns remained, and not only did not collapse but, as stated in Mr. Hagarty's letter, did not even crack. I can assure Mr. Hagarty that we relied on no such miracle in removing column No. 21 from the first story of the Denver building, and that ample and proper supports were provided before it was touched.

Regarding the use of what Mr. Hagarty is pleased to term "mixed construction" of reinforced concrete and structural steel, it is well known that a great many buildings were built in the United States using cast-iron columns and steel or iron beams, the outer ends of the beams supported on concrete, brick or stone walls or piers, many years before structural steel-frame or reinforced-concrete frame buildings were built. Many of these old buildings are standing today in an excellent state of preservation and without showing any serious defects due to the mixing of these materials.

If there is any element of danger in supporting steel beams or girders on reinforced-concrete columns, or in supporting reinforced-concrete columns, floors and beams on steel girders, the engineering profession should certainly be educated without further delay, as this practice is being followed daily and has been pretty firmly established for years by common usage. In fact, when it becomes necessary in a reinforced-concrete building to carry several stories of columns and floors, supported on a clear span, the writer prefers to use structural-steel girders or trusses to save depth, and to fireproof them with concrete.

It is quite possible to calculate the deflection in the steel girder under maximum load and so design it that the deflection will not be excessive or detrimental to the rest of the structure. This is a matter which is up to the designer, whether the building is steel frame, reinforced concrete or "mixed construction."

It may not be amiss to call attention here to the fact that almost all steel-frame buildings are combination structures in that they have reinforced-concrete floors and fireproofing, or hollow tile arches and fireproofing, or brick arches and fireproofing.

It seems to the writer that the work on the Denver building has demonstrated what can be done in reconstruction of reinforced-concrete buildings and that it marks a very important step in the art, as it removes what has been made one of the most serious objections to reinforced-concrete construction in the minds of architects, engineers and owners; namely, the difficulty of making changes.

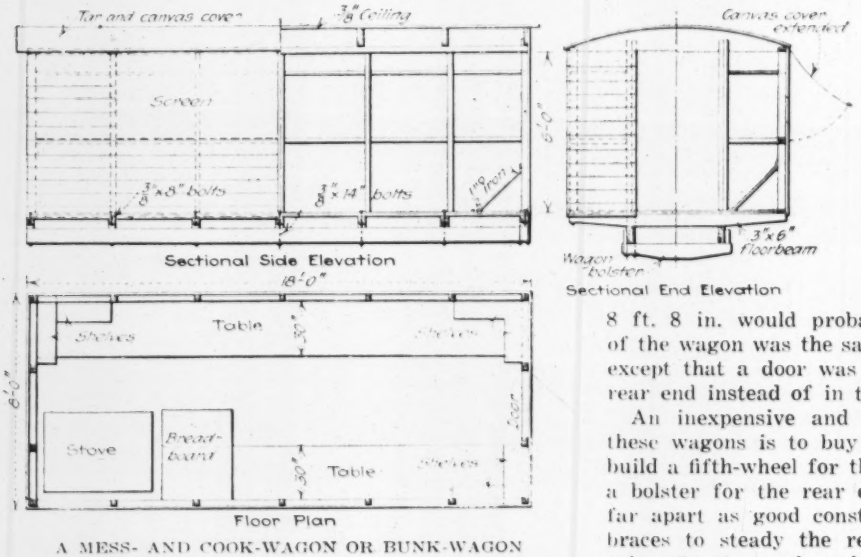
WALTER H. WHEELER.
Minneapolis, June 2.

HINTS FOR THE CONTRACTOR

Mess- and Bunk-Houses on Wheels Make Mobile Construction Camp

By R. M. Adams
Civil Engineer, Montrose, Col.

CAMP units on wheels were the means of materially reducing the labor cost on canal repair work in Idaho, done last year under the direction of the writer. The plan was to have both mess- and bunk-houses always in readiness so that the entire camp could be moved on very short notice, and at the same time entail very little expense. This eliminated the greatest element of inefficiency in this class of work and also increased the morale of the camp by insuring regular, hot meals for the workmen who were often wet all day during the winter months. This item of small labor turnover would in a short time pay for the mess-wagon.



A MESS- AND COOK-WAGON OR BUNK-WAGON

The plan on which the wagon-camp units were constructed was to do as little framing as possible, and still be consistent with good workmanship and appearance, but not to save weight at the cost of sturdy construction. In the main the frames were built up of 2 x 4-in. studding with a canvas-covered roof. Wire screen was placed around the walls at windowsill height, which could be covered with canvas when desired. The construction of the cook-wagon is shown in the accompanying illustration.

The sides were built up of ¾-in. flooring as that was the only material that could be had at the time. The ⅜-in. material used for the roof, or ceiling, it is believed, could replace the heavier material of the sides with considerable saving in weight. The roofing material consists of canvas tarred and sanded lightly. This kind of a covering will withstand the rubbing of low-hanging branches better than any other, and is just as waterproof and durable as any manufactured covering.

The form of rafter construction is such that there could be no eaves. It is therefore an advantage to have the roof covering continue on over the edge of the roof, and up under the blind-stop used as a fastener at the joint of the siding with the roofing boards, and from which the canvas hung loosely as constructed in the bunk-wagons, with a pole at the bottom edge. In the mess-wagons the canvas was attached at the line of the top of the windows; in both wagons the canvas came down to a point 6 in. lower than the window sill. It can be fastened down to keep out rain, snow, or dust, in windy weather, and will aid the cook in keeping the necessary temperature for culinary work. In hot weather it can be set out at an angle to form an awning.

On the work mentioned above one mess-wagon was provided for each camp and as many bunk-wagons as the work on the particular job in hand required. The number of men placed in one wagon varied principally with nationality. The bunk-wagons were made 9 ft. wide, and three bunks were built longitudinally at each end on the floor, or near it, leaving an open space in the center for tables, chairs, and stove. Access is provided by a door in the middle of the side. The cook's wagons were made 8 ft. wide, although a width of 8 ft. 8 in. would probably be better. The framing of the wagon was the same as that of the bunk-wagons except that a door was provided in the center of the rear end instead of in the side.

An inexpensive and satisfactory way to build up these wagons is to buy only wheels and axles and to build a fifth-wheel for the front end, a sand board and a bolster for the rear end, and to place the axles as far apart as good construction will allow, using iron braces to steady the rear axle, rather than a reach pole. On the work under the writer's direction all of the fifth-wheel was made in the blacksmith shop of the repair department except the plates which were purchased for $8 per set—cheaper than they could be made. It was found that three-point suspension greatly reduced strains on the wagon-body, and it is essential that the mess-wagons have fifth-wheels when used on canal banks, as it is possible to get the wagons to and from places that would otherwise be inaccessible; it is not impossible to turn one of these wagons on an 18-ft. canal bank.

The construction of these wagons is lighter than the car for somewhat similar purpose described in *Engineering News-Record*, Feb. 27, 1919, p. 444. The light construction makes it possible to handle them easily, and when hooked behind a tractor or to a truck, they are not likely to break in the running gear. For several reasons they would be very acceptable for highway work. Based on the prices in the northwest during 1919, one of these bunk-wagons costs nearly $175 and a cook-wagon $200.

NEWS OF THE WEEK

New York, June 9, 1921

Federation Receives Report on Waste in Industry

Committee Finds that Management Is Responsible for 50 Per Cent and Labor 25 Per Cent of Wastes

After a discussion during which it appeared, for a time, that the report of the committee on the elimination of waste in industry, charging that "over 50 per cent of the responsibility for these wastes can be placed at the door of management and less than 25 per cent at the door of labor," might be repudiated, the executive board of the American Engineering Council, the governing body of the Federated American Engineering Societies, at its meeting in St. Louis, June 3, unanimously approved the document on the condition that it be issued only as a signed committee report. An abstract of the report appears elsewhere in these columns.

Following a conference between Edwin S. Carman, representing the federation, and H. O. Garman and C. E. Drayer, president and secretary, respectively, of the American Association of Engineers, the executive board of the federation passed a resolution appointing a committee to consult with a similar committee of the American Association of Engineers with a view to establishing some basis of co-operation between the two organizations. It is understood that the appointment of such a committee by the American Association of Engineers has not as yet been authorized.

Committee Reports

The committee on licensing of engineers objected to Section 39-0 of the recently amended New York law, which states, in part, that "nothing herein shall apply to a corporation, partnership or joint stock association provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock associations shall be licensed engineers." It was pointed out that the revised section, from which the foregoing has been quoted, was an unsatisfactory attempt to meet the criticism of the Attorney General with regard to a former section (No. 14) which had been declared unconstitutional. The report was referred back to the licensing committee with instructions to prepare an additional report for the next meeting.

A motion was carried approving the Temple bill calling for appropriations to be used in the completion of the topographical survey of the United States.

The water power committee reported in favor of a "hands-off" policy with regard to the Federal Power Commission.

The committee on engineering research recommended that government appropriations for research be distributed among colleges suitably equipped for such work whether or not they be classified as land-grant institutions.

Bill in Congress Authorizing New York Port Compact

A bill authorizing the establishment of the Port of New York Authority and the port compact between the States of New York and New Jersey was introduced in the House of Representatives May 26, following the introduction of a similar bill in the Senate.

License Law for Pennsylvania

House bill 204 to regulate the practice of professional engineering and land surveying in Pennsylvania was signed by Gov. William C. Sproul May 26. The act becomes effective June 1, 1922.

The bill follows the model law of Engineering Council, with modifications to conform to local requirements. Corporations and co-partnerships are not exempted, as all practitioners come under the law. The section of the measure referring to corporation practice is as follows: "A firm or a copartnership or a corporation may only engage in the practice of the profession of engineering or land surveying in this commonwealth in the name of the person or persons connected with such firm or copartnership or corporation who is or are in responsible charge of the design or of the execution of the work which constitutes such practice each of whom is registered as a professional engineer or as a land surveyor."

The American Association of Engineers, mainly through the Harrisburg, Philadelphia and Pittsburgh chapters, were the main sponsors of the bill. Some minor opposition developed at the public hearings before the ways and means committee from engineers resident in southeastern Pennsylvania.

The bill had a turbulent voyage. Attempt was made to kill it in committee, but once on the floor it passed by a five to one vote. Next, through activities of officials of the state highway department, it was referred to the judiciary committee and was not brought to a vote until the closing hour of the session, when it was passed by the Senate. It was then held up by the Governor for two days less than one month.

Early Action on New Federal Aid Road Bill Probable

No Difficulty Expected in Harmonizing Differences Between Townsend and Dowell Measures

(Washington Correspondence)

Prospects favor the early enactment of federal highway legislation. A compromise measure will be fashioned from the Townsend and Dowell bills, which are being actively considered in Congress. Hearings on the Townsend bill were concluded by the Senate committee on post offices and post roads June 2. Hearings on the Dowell bill were still in progress before the House committee on roads on that date.

The Senate committee, in the light of the testimony which it has taken, will make several amendments to the Townsend bill, as introduced. One of these will make it clear that the selection of the roads is to be made in co-operation with the state highway commissions. The Dowell bill probably will be reported to the House in substantially its present form.

The Senate is expected to pass, without material change, the Townsend bill in much the same form that it will be presented by the committee. The House unquestionably will pass the Dowell bill. The differences in the two bills will be harmonized in conference. The indication is that no great amount of difficulty will be experienced by the conferees in blending the bills into a measure on which they can agree.

Philip Perlman, Secretary of State for Maryland, was one of the recent witnesses appearing before the Senate committee. He said, in part:

"One objection that we have to the Townsend bill is that the commission is to be given power to determine what roads are to form the interstate system. The states are given no choice in that selection. That is a very serious matter. The state commission should make the selection subject to the veto of the federal government, as has been the custom in the past. It also is a serious matter for us that the commission should have the power to make roads conform to a certain standard. All of our roads are not 20 ft. wide. We do not have the 66-ft. right of way in many instances. After we have spent our money on roads we should not be confronted with legislation of this kind. We would rather not have such standards put in the bill. What you are doing, and it may be unintentional, is having a bill that gives state aid to a federal project instead of federal aid to a state project."

(Continued on p. 1011)

Disastrous Colorado Floods Follow Great Rainstorm

Large Part of Pueblo Destroyed—Heavy Precipitation Causes Unprecedented Stages in Upper Arkansas and South Platte Rivers

EXTREME floods devasted the valley cities of central and southern Colorado east of the continental divide between June 4 and June 6. The worst damage was done in Pueblo, where the waters of the Arkansas River and its tributary, Fountain Creek, rose 15 ft. above the highest previous stage and submerged over 300 city blocks, destroying a great number of buildings and causing deaths estimated by hundreds. No dependable figures of damage have been compiled up to the present, but amounts reported from various points indicate a total of $20,000,000 to $25,000,000, of which nearly $15,000,000 represents the Pueblo loss.

Two rivers, the Arkansas and the South Platte, drain the region east of the continental divide, which passes north and south somewhat west of the middle of the state. Their drainage areas, embracing this region from Greeley and Fort Collins in the north to the New Mexico state line in the south, were covered by an abnormal, long-continued rainstorm beginning on June 2 but reaching its maximum on June 3 and 4 and in part continuing until June 5 and 6. J. M. Sherier, U. S. Weather Bureau district forecaster at Denver, in a telegram to *Engineering News-Record* describes the cause of the floods as torrential downpours on the eastern slope of the continental divide, of whose maximum intensity there is probably no record. Apparently the most intense rainfall affected the southerly half of the area described, forming the upper drainage area of the Arkansas, while somewhat less heavy but longer-continued rains fell over the South Platte drainage area. Pueblo, the chief city in the former region, was by far the worst sufferer, and damage to roads and bridges in this region is also reported the most serious. Denver and other cities in the northern region suffered relatively little, but extensive damage was done to agricultural lands and to bridges and the highways in the South Platte area also.

Heavy Rainfall for Several Days

Robert Follansbee, district engineer of the U. S. Geological Survey, reports that the Arkansas and South Platte Rivers reached their highest stages for many years as the result of unseasonable extreme rains occurring at a time of normal high water stages from melting snow in the mountains. Forecaster Sherier gives the precipitation in the night of June 3-4 at Pueblo as 2.88 in., but expresses the opinion that a much heavier precipitation occurred in the area just above the city. The Pueblo figure for June 3-6 is 6.18 in. The storm thus is closely comparable in intensity and extent with the Central States storm of March, 1913, while the steepness of the drainage area rendered the effects relatively more severe; the Arkansas River after emerging from the Royal Gorge in the neighborhood of Canyon City falls about 500 ft. in 35 miles to Pueblo. Flood stage at Pueblo is about 10 ft. The highest previous flood is reported as 14.3 ft., but the crest of the present flood reached 30 ft. (estimated).

No rainfall figures for the South Platte drainage area are as yet available. but J. E. Maloney, state highway commissioner, reports excessive rains over the entire drainage area for Ft. Collins to the southern divide at Palmer Lake.

Failure of several storage dams, among them three dams on Beaver Creek, a northern tributary of the Arkansas near Florence, is reported to have intensified the flood conditions on the morning of June 5. No definite account of the damage to these structures has been obtainable, however, up to the moment of going to press. The Skagway dam near Cripple Creek and some smaller dams in the mountains are said to have failed.

Little loss of life occurred along the South Platte and its tributaries. Large property damage was done here, however, according to Mr. Follansbee.

Much Agricultural and Highway Damage

Millions of dollars of damage to agricultural interests are reported in both the Arkansas and South Platte areas. Highway damage is extensive in both the northern and southern regions, according to J. E. Maloney. This latter figure is estimated at $1,000,000 for the Arkansas and probably almost as much for the South Platte. According to one report, every bridge over the Arkansas for many miles was washed out. Mr. Maloney reports a bridge at Hadley and a bridge at Las Animas washed out east of Pueblo, but others in that part of the state uninjured. A stone arch bridge over Fountain Creek at Buttes was destroyed and a temporary structure is under construction there now. In the South Platte region most of the county bridges on the tributaries are out, but none on the main river; the road damage in this region is very great, however.

By June 7 energetic efforts were being made to re-establish communication with Pueblo from east and north, including railroad service; communication from the south had not been badly disturbed. The state highway authorities were then at work repairing road damage and had already restored many of the main thoroughfares.

Belle Isle Bridge Contract Let on New Bids

As the result of receiving favorable bids on May 21, on the fourth advertisement for the construction of the Belle Isle bridge at Detroit, the city has let contracts for the structure to Greiling Bros., of Green Bay, Wis., and the Wisconsin Bridge & Iron Co., of North Milwaukee, Wis.

The total cost will be $2,365,850, which comes within the amount available, the balance of the $3,000,000 bridge fund voted in 1917. Construction of the bridge will be started within a month. The work has been under consideration since the old bridge burned, six years ago.

Greiling Bros. were awarded the contract for work in Groups A, C, and D, comprising all the work except the structural steel and bronze bearings. For the substructure work they bid $1,278,180, for concrete work in the superstructure $690,235, for waterproofing $23,280, and for handrailing and lamp posts $20,000. The one contract, covering the above items, totals $2,011,695. The Wisconsin Bridge and Iron Co. bid $354,135 on the structural steel and bronze bearings.

Twelve Firms Bid

Twelve firms bid on all or part of the work, and two companies bid on all groups to complete the bridge. Greiling Bros. and the Arundel Corporation, of Philadelphia, bid on all groups. Greiling Bros.'s bid on the structural steel and bronze bearings was $406,400, making that firm's bid for the complete structure $2,418,095. The Arundel Corporation's bid of $2,355,237.50 was informal in that it was not on the regular form and stipulated that the city should furnish an unloading dock for the construction material, and also that the city should furnish all cement to be used in the structure. Although the bid was first considered to be the low bid, the additional cost of the cement made it in excess of the funds available. The bid was rejected.

In recommending that the contracts be awarded, the Commissioner of Public Works cited that the combination of two firms' proposals in part makes the awarding of contract legal, in that the available balance remaining in the Belle Isle Bridge Fund is not exceeded, the Controller's records showing a credit balance of $2,370,653.28 in the fund.

The city council voted unanimously in favor of the contracts recommended by the Department of Public Works, and Mayor Couzens has signified his approval of the council's action. The bridge will be construced according to revised plans for a cantilever type bridge as prepared by Esselstyn, Murphy and Hanford, the engineers in charge of the design and supervision of construction. The subway approach under Jefferson Ave. at the north end of the bridge has already been completed, at a cost approximating $400,000.

State Sanitary Engineers Perfect Their Organization

The Conference of State Sanitary Engineers, which was tentatively formed at the New Orleans meeting of the American Public Health Association in 1919 and which met in Washington in 1920, perfected its organization by the adoption of a constitution at Boston last week. The constitution provides that the members of the conference shall consist of the chief sanitary engineers of state boards and departments of public health and similar officers of other state departments doing sanitary work, together with three sanitary engineers from the U. S. Public Health Service. Each state and also the U. S. Public Health Service will be entitled to but one vote. Besides the usual executive officers the sanitary engineer of the U. S. Public Health Service on duty at Washington headquarters—at present I. W. Mendelsohn, associate sanitary engineer—will serve as corresponding secretary.

NEW OFFICERS

Officers elected for the ensuing year are: Chairman, C. A. Emerson, Jr., engineer, Pennsylvania State Department of Health, Harrisburg; vice-president, W. H. Dittoe, engineer, Ohio State Board of Health, Columbus; secretary-treasurer, Theodore Horton, engineer, New York State Department of Health, Albany.

The Boston conference last week, which preceded the nineteenth annual conference of state and territorial health authorities with the U. S. Public Health Service, held two sessions each on June 1 and 2 with a full program of committee reports and papers and very active discussions on water supply, sewage disposal, mosquito control, pasteurization and other phases of public milk supplies, sanitation of swimming pools, rat proofing, and other lines of work conducted by the state and federal health departments.

A large part of the time of the conference was devoted to a consideration of the certification and the general supervision of water supplies for railways and vessels engaged in interstate commerce. This certification is by the U. S. Public Health Service (Treasury Department) acting in co-operation with state departments of health. The Public Health Service wishes the several state departments of health to agree upon a method of certification before the printing of new regulations. There was so much divergence of opinion regarding some of the points at issue that the matter was finally left to a committee for adjustment, with the expectancy that the committee would reach an early conclusion.

A comprehensive paper on "State Sanitation" was read by George C. Whipple, professor of sanitary engineering, Harvard University. Another paper which was listened to with great interest was on "The Typhoid Epidemic at Salem, Ohio," by W. H. Dittoe, engineer, Ohio State Board of Health (see *Engineering News-Record*, Dec. 23, 1920, p. 1244, for a summary of this epidemic).

Notable reports, with recommendations as to rules to be established by or to be used for the guidance of state departments of health, were submitted as follows: Water Supply, W. H. Dittoe, chairman; Cross Connections and By-Passes on Water Supplies, S. Pincus, associate sanitary engineer, U. S. Public Health Service, New York City; Milk Supply, C. A. Emerson, Jr.; Stream Pollution and Sewage Disposal, E. H. Ehlers, engineer, Texas State Board of Health; Mosquito Control, R. Messer, engineer, Virginia Department of Health; Swimming Pools, S. DeM. Gage, chemist and sanitary engineer, Providence State Board of Health.

It is expected that the committee reports and papers will be printed by the U. S. Public Health Service.

Report on Industrial Wastes

Waste in industrial processes is causing enormous annual losses to the nation, it is declared in a report of the American Engineering Council's committee on elimination of waste in industry, made public at a meeting of the council's executive board at St. Louis, Mo., June 3. "Over 50 per cent of the responsibility for these wastes," the report says, "can be placed at the door of management and less than 25 per cent at the door of labor." The findings of the committee, which was appointed by Herbert Hoover, cover investigations of typical industries.

The investigation found that the margin of unemployment mounts to more than a million men, that billions of dollars are tied up in idle equipment, that high labor turnover is a rough index of one of the commonest wastes, and that the waste of time, energy and money through duplication of estimates and bids in the building trades runs into millions annually.

Both employer and employee restrict output, it was said. Both capital and labor are blamed for existing abuses, but the annual losses through waste by conflicts between them is much less than popularly supposed.

Between four and five million workers were idle during January and February of this year. In 1921 half a billion dollars will be lost in wages in the building trades, it is said. Nation-wide machinery to obtain continuous information concerning unemployment conditions throughout the country is said to be necessary. Means for regularizing employment in the principal industries is also urged. An elaborate plan of nation-wide co-operation involving the government, the public, trade associations, the industries, labor, bankers and engineers, is outlined.

The waste inquiry was in charge of a committee of sixteen headed by J. Parke Channing, of New York, as chairman, and L. W. Wallace, of Washington, executive secretary of the American Engineering Council.

Pasadena Adopts City Manager Form of Government

The city manager form of government was put into effect in Pasadena, Cal., early in May and C. W. Koiner, former superintendent of the Pasadena municipal lighting and power department, was elected to the office of city manager. Press reports state that 64 candidates sought the position.

To Study Jersey Watershed

The New Jersey State Department of Conservation and Development has authorized an investigation by the firm of Hazen, Whipple & Fuller, consulting engineers, of New York, of the unappropriated watersheds of the state with particular reference to the needs of the metropolitan district. The study will show what waters in North Jersey are still available, their character, and the cost to transport them. The Conservation Department has also made a decision to establish upon all the principal streams in the state a series of gaging stations. In this undertaking the U. S. Geological Survey will co-operate.

Commission to Make Inquiry Into Panama Administration

Secretary of War Weeks has appointed a commission of four men, three of them engineers and the fourth an executive of a public utility corporation, to investigate conditions in the Panama Canal Zone with a view to determining reforms necessary to make the zone more efficient and less expensive as a government going concern. The chairman is Brig.-Gen. W. D. Connor, Corps of Engineers, U. S. A., who is in charge of the inland waterway service of the War Department and the other members are Albert Brooks Fry, supervising chief engineer, U. S. Public Buildings, Port of New York; Col. F. A. Molitor, consulting engineer, New York City and Harley T. Wilson, president, Western Power Corp., New York. The commission sails for Panama June 10.

Engineers Appointed on Columbus City Planning Commission

A city planning commission of four citizens and four ex-officio members has been appointed for Columbus, Ohio, under a state law passed some years ago and a city ordinance passed this year. The citizen members of the committee are Frank H. Eno, professor of municipal engineering, Ohio State University; John E. McCrehen, president of the Columbus Real Estate Board; Frank L. Packard, architect, and Robert F. Wolfe, a newspaper publisher. The ex-officio members are Robert H. Simpson, city engineer, and W. H. Duffy, service director. The commission has advisory powers only, is unpaid, and will be served by the city engineering department. Zoning, rerouting street cars, and a civic center will be considered by the commission.

Railroad Security Owners Appoint Engineer Board

Announcement was made June 6 of the appointment by the National Association of Owners of Railroad Securities of a board of economics and engineering, consisting of six prominent engineers, headed by Col. F. A. Molitor as chairman. The board consists of John F. Stevens, late head of the American railway mission to Russia, who was previously chief engineer of the Panama Canal and chairman of the Isthmian Canal Commission for two years; Col. F. A. Molitor, who had charge of the reorganization, under the Director of Military Engineering and Engineer Supplies of the A.E.F., of distribution and receipt of supplies from principal bases and who was previously for three years supervising railroad expert for the government in the Philippine Islands; J. F. Wallace, chairman, Chicago Railway Terminal Commission, who was associated with Mr. Stevens in the Canal Zone; W. L. Darling, for many years chief engineer of the Northern Pacific Ry., who during the war was an associate member of the Naval Consulting Board and a member of the Russian Railway Mission; Lewis B. Stillwell, railroad electrification engineer, who was previously electrical director, Interborough Rapid Transit Co., New York City, and W. W. Colpitts, consulting engineer, who until 1913 was chief engineer of the Kansas City, Mexico & Orient Railway Co.

The daily press announced last Monday that the board would be headed by Mr. Stevens. Since Mr. Stevens is to return to Russia to resume his railroad work there, Col. Molitor has been named to head the board.

According to the announcement of the association, "the work to be performed by this board is regarded as an important step in the solution of the transportation problems now confronting the country." At the time of the appointments, S. Davies Warfield, president of the association said, "No member of the Board of Economics and Engineering is connected with any railroad company or any financial institution. This board is unhampered by ties of individual, railroad or financial identity or ownership, or by the influences of any particular security owning or banking group. It is free from the environment that attends governmental appointment. It can pursue its investigations and reach conclusions solely with the purpose of securing the substantial economies that can be made in the public interest."

Housing Division Recommended

The Committee on Commerce of the Senate has recommended favorably to the Senate the Calder bill, which has as its object the creation of a division of construction and housing in the Bureau of Standards of the Department of Commerce. The committee endorses the arguments of the Secretary of Commerce in favor of such a division.

Detroit-Windsor Bridge Companies Are Organized

Passage of the charter and franchise of the Canadian Transit Co. by the Canadian Parliament completes the legal preliminaries to prosecution of the Detroit-Windsor bridge work, it is reported. Congressional authority for building the bridge was granted to the American Transit Co. two months ago, and arrangements are being completed for joint action of the two companies. It is planned to appoint a board of consulting engineers, consisting of four bridge engineers of international prominence to co-operate with C. E. Fowler, chief engineer, in supervising the development of the detail design. Proposals for financing the undertaking have been received and are expected to be acted upon as soon as the directors of the joint corporation can meet. Mr. Fowler states that the structure is to be a wire-cable suspension bridge of about 1,800-ft. span, with two 28-ft. roadways, two 7-ft. sidewalks, and two electric railway tracks on the upper deck. A lower deck will provide for four railway tracks.

New Federal Power Regulations

The Federal Power Commission, meeting in a special session May 27, approved the amendments to the regulations, promulgated for the administration of the Waterpower Act, with the exception of the proposed multiple in the specified rate of return and the regulation dealing with the allocation of earnings. The commission affirmed the multiple 1.5 and approved a revised form of the existing regulation on allocation which allows permittees or licensees to propose a basis of allocation before the issuance of a permit of license, but subjects such a basis to review at not less than five-year intervals. The commission also approved an additional paragraph to regulation 20, which requires licensees to file copies with the commission of annual reports made to the state commissions or to their stockholders.

The application of the Arkansas Hydroelectric Co. was denied because the chief of engineers reports that the Little Red River is navigable at and above the site at which it is proposed to build the dam. Public lands also are involved.

Batchelder Killed in Plane Crash

A. G. Batchelder, chairman of the executive board of the American Automobile Association, Washington, D. C., was killed May 28 when an army airplane, on which he was a passenger, encountered a severe storm near Morganstown, Md., and crashed to earth. With Mr. Batchelder in the machine were one other civilian and five army officers, all of whom lost their lives. As an advocate of good roads Mr. Batchelder had a wide acquaintance among highway engineers and for years was a consistent attendant at the various road conventions.

Warehouse Association to Hold Meeting in Pittsburgh

Representatives of manufacturing companies, distributing their products through public merchandise warehouses, will meet in convention at the William Penn Hotel, Pittsburgh, June 16 and 17, 1921, under the auspices of the Shippers' Warehousing and Distributing Association, organized in Chicago a year ago for the general purpose of effecting standardization of practice in the warehouse industry. Kent B. Stiles, 239 West 39th St., New York City, is secretary of the association.

Chicago Meeting of A. S. M. E.

Changes in the organization of engineering societies to accord with the increasing importance of the position which the engineer is taking in our social economy were suggested by Morris L. Cooke, Philadelphia, Pa., in a paper read at the spring meeting of the American Society of Mechanical Engineers, held in Chicago on May 23 to 26. He argued particularly for more effective administrative control, for a secretary who is a manager with authority instead of being servant to a board of directors, and for larger development of the non-technical mind of the profession, so as to give voice to the engineering opinion of the nation.

Special sessions on the Chicago railway terminal association and on highway construction plant were unusual features of the meeting, and the relations between engineering education and engineering industries were discussed in a joint paper by Magnus W. Alexander, New York, and Dugald C. Jackson, Cambridge, Mass. Apart from these subjects the various sectional meetings were devoted mainly to such technical and mechanical matters as machine tool work, boilers and fuels, modern locomotive design and hydroelectric plants.

McClellan President of A. I. E. E.

At the annual business meeting of the American Institute of Electrical Engineers held in New York, May 20, William McClellan, of Philadelphia, Pa., was elected president. Dr. McClellan graduated from the University of Pennsylvania and has been prominent in electrical engineering for twenty years. He has served as engineer in charge of construction for the Philadelphia Rapid Transit Co., with the Westinghouse, Church, Kerr Co., particularly in connection with electrification on the Erie R.R., was chief engineer of the Public Service Commission, Second District of New York, assistant to the president of the Buffalo General Electric Co., dean of the Wharton School of Finance and Commerce of the University of Pennsylvania, and vice-president of the Cleveland Electric Illuminating Co. Since early this year he has been in independent consulting practice in Philadelphia.

California Convention Discusses Municipal Power Projects

Under the auspices of the California League of Municipalities a convention was held in Sacramento, Cal., on May 20, which was attended by over fifty mayors and other officers of California cities to discuss ways and means of aiding cities and organized rural districts in undertaking the development and ownership of hydro-electric power on a large scale. Prominent in the proceedings was the discussion of Senate Bill 18, which has recently become a law and which legalizes co-operative organizations of and between political subdivisions of the state which wish to join in certain undertakings. The sentiment of the convention was strongly opposed to private ownership of utilities and many speakers expressed the opinion that the power companies were not fair to the rights of the people and the industries of the state.

In addressing the meeting Governor Stephens stated that while fair returns for the honestly invested capital of privately owned public utilities should be protected, yet he hoped that districts, cities and counties would be able to develop hydro-electric power for their own uses. Charles H. Lee, president of the State Water Commission, stated that although there were about 9,500,000 hp. water power in California which could be developed 1,000,000 hp. had already been developed and applications were on file for an additional 7,000,000, among the latter being some claims which overlap and some sites which are not financially feasible to develop. Mr. Lee felt that the most probable result of the attempt by municipalities to get possession of the few available sites would be that the permitees would use increased diligence in developing the 7,000,000 hp. on which filings have already been made.

The convention decided to draft an agreement under the authority of Senate Bill No. 18 to form organizations for studying the hydro-electric situation looking toward power development by municipalities. The convention also resolved to redraft the Johnson act for presentation at a special session of the Legislature or, failing in that, at the next general election. The Johnson act, which was defeated in the Senate during the recently closed Legislature, was a measure supported by the league and designed to create a hydro-electric power commission modeled after the Ontario commission.

Tunnel Deadlock Ends

Agreement was reached June 7 by the New York and the New Jersey Tunnel commissions on plans for the Jersey entrance and exit of the Hudson River vehicular tubes, thus breaking a deadlock which has been delaying construction work for several months. Bids for the Jersey shaft will soon be called for.

Mechanical Engineers Discuss Road Building Machinery

Three papers and a brief general discussion on machinery for paved road construction occupied a session at the spring meeting at Chicago, May 23-26, of the American Society of Mechanical Engineers. The papers were: "Planning and Organizing a Road Job for Mechanical Handling of Material," by C. D. Curtis; "Road Construction Plants," by B. H. Piepmeier, and "Mechanical Needs in Highway Construction Machinery," by R. C. Marshall, Jr. An abstract of the first paper was published on p. 949 of last week's issue. The discussion was brief and turned largely on the economy of large and small plants, with the conclusion that the larger plant offered advantages where conditions were favorable for its use.

Federal-Aid Road Bill Hearings

(Continued from p. 1007)

Mr. Perlman's testimony was supplemented by that of John N. Mackall, chairman and chief engineer of the Maryland State Roads Commission, who said:

"We have co-operated with the Bureau of Public Roads in a most satisfactory manner. There never has been a serious disagreement between us. We believe that we can continue to co-operate with that bureau and build and maintain roads satisfactory to the federal government. The intent of this bill is very clear that the federal government, without regard to the state, shall select a federal system.

"The width of 66 ft. for the right of way would be unfortunate. There are many places where to acquire a right of way 66 ft. wide would actually cost more than to construct the surfacing 66 ft. wide.

"Roads in Maryland are costing an average of $33,000 a mile for concrete for roads 15 ft. wide, and $12,000 a mile additional for a 20-ft. road. Money is costing 5½ per cent. Interest on that additional $12,000 that you would invest would be $660 a year. That interest alone will maintain the road. You can let the interest compound above the cost of maintenance. If you need to widen a road in ten or twenty years you will have sufficient funds from the interest alone to do the work without impairing the principal. I think widening should be done from current receipts from automobile licenses.

"Co-operation in the selection of roads is an absolute necessity if federal aid is to be a success. We hope this Congress will commit itself to a policy of federal aid along lines that we all can follow and build and maintain our roads and not spend our time in Washington."

During the course of the hearing Senator Townsend made the following statement:

"There are probably not three states in the Union that would insist on taking out of the federal appropriation for road construction any money for the purposes of maintenance. Practically all the states insist that they want to maintain the roads and that they want all the money appropriated to be used in constructing roads.

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, was recalled to the stand for further cross-questioning. In the course of his answers he made the following statement:

"If into this law there could be written a regular procedure by which the state would select a system of roads, having regard to the service of the state, the population within the state, and the interstate traffic, they could be given certain specifications for the selection of the roads which could then be put up to the federal authority and examined to see if the roads selected meet those conditions. I do not believe that the federal government should go into local fights. If authority is assumed to arbitrate disputes as to which of two roads shall be followed, assuming that both roads meet the conditions set up in the law, I believe the federal government would have an endless number of disputes on its hands to settle —particularly disputes which have been disposed of once."

P. St. J. Wilson, chief engineer of the Bureau of Public Roads, testified that "there should be a reasonable system of through roads and federal money ought to be concentrated on that system. The more important sections could be improved first just as every state is doing and just as every county is doing."

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Engineering Council of Utah was addressed May 20 by H. C. Boyden, of the Portland Cement Association, on the fundamentals for obtaining good concrete.

The Engineers' Club of Philadelphia, Pa., at its luncheon meeting, June 14, will be addressed by Colonel Henry S. Spackman on "German Reparation—Its Economic Relation to the United States."

PERSONAL NOTES

LESLIE H. ALLEN, recently with Fred T. Ley & Co., contractors, Springfield, Mass., as an industrial housing engineer and later as sales manager for the New England territory, has joined the staff of the Portland Cement Association, Chicago, Ill., as assistant manager of the cement products bureau.

ERNEST MCCULLOUGH has been engaged as associate editor, of the *American Architect*, New York. During the World War he spent 27 months in France. He resigned recently from the Army, where he had served in the Chemical Warfare Service with rank of lieutenant-colonel.

ALBERT O. TRUE, until recently captain, Engineers, U. S. A., and in charge of government water supplies at Newport News, Va., and vicinity, has been retained by W. J. Sherman, consulting engineer of Toledo, Ohio, as resident engineer on the construction of a reservoir and filter plant for the town of Wauseon, Ohio.

I. H. SCHRAM, superintendent of terminals, Erie R.R., at Marion, Ohio, has been appointed division engineer with headquarters at Marion.

F. L. WHEATON, formerly division engineer of the Delaware, Lackawanna & Western R.R., with headquarters at Binghamton, N. Y., has been transferred to Buffalo, where he will have jurisdiction over both the Buffalo and Scranton divisions.

J. WARREN MYLCHREEST, of Mylchreest Brothers, general contractors, Middletown, Conn., has been appointed city engineer of Middletown.

ROBERT B. FULLER, formerly resident engineer on cotton mill construction with Lockwood, Greene & Co., engineers, Atlanta, Ga., is now a member of the firm Coate-Fuller Construction Co., Piqua, Ohio, general contractors on concrete and building construction.

PATRICK PHILIP, of Vancouver, B. C., has been appointed chief provincial engineer for district 4 of the Dominion Department of Public Works.

ROBERT COLTON, JR., for some time engaged in special engineering projects in China, has joined the firm of Glenville & Collins, engineers, at Vancouver, B. C.

BERT C. WELLS, formerly city manager, El Dorado, Kan., has been appointed city manager of Atchison, Kan.

J. T. ANDERSON, formerly with the Pennsylvania State Highway Department, is now general superintendent for N. M. Leigh, contractor, at Mannington, W. Va.

J. S. BRIGHT, former district engineer for the U. S. Bureau of Public Roads at Denver, Col., has been transferred to San Francisco, where he will assist Dr. L. I. Hewes.

J. W. BALL, for the past seven years with the U. S. Bureau of Public Roads as engineer in charge of construction, has been assigned to regional headquarters at San Francisco under the direction of Dr. L. I. Hewes.

R. W. PARKE, formerly resident engineer with the North Carolina State Highway Commission in the second division, has been appointed construcion engineer for the new seventh district with headquarters at Elkin, N. C.

C. S. CURRIER, formerly location engineer for the North Carolina State Highway Commission, second division, is now district engineer, seventh district.

U. L. FISHER, formerly resident engineer, second division, North Carolina State Highway Commission, has been appointed maintenance engineer for the seventh district.

MAJOR D. Q. MCCOMB, formerly division engineer, has been appointed chief engineer of the Tennesse Highway Department. Major McComb is a mechanical engineer graduate, '00, of Colorado Agricultural College; a civil engineer graduate, '10, of University of Illinois, and a post-graduate in highway engineering of Columbia University in the City of New York. He is an engineer of over 13 years' experience, in the employ of the Philippine Bureau of Education; in the Philippine Bureau of Public Works as assistant and district engineer; with the Pittsburgh Testing Laboratory, Birmingham, Ala., as chemist; as highway engineer, U. S. Bureau of Public Roads, and as division engineer, Tennessee Highway Department.

ALLAN V. GARRATT, formerly chief engineeer of the Lombard Governor Co., and more recently consulting hydraulic engineer to Lockwood, Greene & Co., engineers, has opened an office in Boston, Mass., for consultation and advisory work in hydraulic engineering.

WILLIAM COUPER, former assistant general manager of the Associated General Contractors of America, recently acecpted an executive position with the Texas Co., New York, entering upon his new duties June 1.

EUGENE GEDNEY, county assistant for the New York State Highway Department for ten years, and recently assistant engineer in the valuation department of the New York Central R.R. in Cleveland, is now engaged in the contracting business in Cleveland, specializing in reinforced concrete structures, streets, roads and pavements. He has been awarded the contract for the construction of ten bridges in Cuyahoga County.

C. E. DRAYER, national secretary of the American Association of Engineers, was awarded the honorary degree of doctor of science by Ohio Northern University, his alma mater, on May 25 at the fiftieth anniversary of the founding of the university.

W. A. BECHTHOLD, formerly assistant county highway commissioner of Racine County, Wis., has been appointed Racine County Highway Commissioner.

OBITUARY

A. O. LEACH, engineer who served on the construction of the army base at Sewell's Point, Norfolk, Va., died May 8 in Norfolk. He was born in Ontario, Canada, in 1885 and was educated in civil engineering in Canadian colleges. He was for twelve years connected with the engineering department of the Great Northern Ry., his latest position being that of valuation engineer. In 1917 his services as a civilian were accepted by the United States Government and he was detailed for duty as supervising engineer in charge of the Camp Dodge cantonment at Des Moines, Iowa. In the same year he made investigations of the two proposed sites at Norfolk for the army base and recommended its construction on Sewell's Point.

J. FREMONT ARMSTRONG, secretary of the Minnesota Federation of Architectural and Engineering Societies and editor of its official publication, died at White Bear Lake, near St. Paul, Minn., May 10. He had varied experience as an engineer, a school teacher, newspaper editor and a publisher. He was also supervisor of allotting claims in the Bureau of Indian Affairs.

EDGAR M. GRAHAM, consulting engineer, of Muskogee, Okla., since 1910 died May 14. He was born in Buffalo, N. Y., in 1881. For more than ten years he was chief engineer of the Muskogee Electric Traction Co. He built 10 mi. of the Webbers Falls Ry. Co. In 1900 he was assistant to Guthrie & Diehl, consulting engineers, Buffalo, N. Y.; worked the following year with the New York Central and then for two years was with the Lackawanna Steel Co. In 1905 he became chief draftsman for the Buffalo & Susquehanna Ry. Co. and in 1907 was assistant chief engineer. He entered private practice in 1908 in Buffalo. Mr. Graham was active in engineering society affairs. At the time of his death he was president of the local chapter of the American Association of Engineers.

KARL G. ROEBLING, president of John A. Roebling's Sons Co., Roebling, N. J., died May 29, at Spring Lake, N. J. He was born in Trenton, N. J., in 1873 and was graduated from Princeton University in 1894. He was one of the directors of the Trenton Brass & Machine Co., the Otis Elevator Co. of New Jersey, the Standard Fire Insurance Co., the Woven Steel Hose & Rubber Co. and the Durable Wire Rope Co., of Boston, Mass.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Conditions in the Common Brick Industry

According to the June digest of the Common Brick Manufacturers' Association of America there has been an average price reduction from the peak of 33 per cent in brick. At the height of the demand for materials a year ago a composite price was taken from the reports of the membership of the association, representing 60 per cent of the country's production, which gave $24 per thousand as the average price. By Jan. 1 the price had settled to $20.05 per thousand and current reports as of May 1 show the figure to be $16.11. The lowest price quoted in any section of the country is from the southeast, where keen competition has even outdone Chicago, which, due to its favorable quality of clay and high plant efficiency, usually holds the record for minimum price. Some brick have been sold, says the digest, in Mississippi and Georgia for $9 per thousand.

Current reports show fewer plants closed, a slight reduction of stocks on hand, and indications of a little more business on the books. Orders on hand for May 1 totaled 114,875,000 brick, and today the figure is increased to 127,590,000. Of the 115 plants reporting to the association forty-nine are closed due to lack of orders. On May 1 there were eighty-four plants closed.

The digest continues: "A strange situation of a little demand producing lower prices rather than higher prices has arisen in some sections. Wherever a few orders have developed brick men have magnified the demand, resumed operations and produced a surplus which developed price-cutting competition."

Freight rates continue to be the greatest handicap in the way of construction, says the digest. Questionnaires taken by the association from its membership indicate that there have been increases in the freight rates on brick since 1915 between plants and principal markets of from 100 to over 500 per cent, the average increase being shown as 200 per cent. As a result a considerable percentage of the brick now being moved is forced to use trucks because the short-haul railroad rates are considered prohibitive.

Chicago Labor Leader with Fifteen Aids Indicted

"Mike" Boyle, Chicago labor leader, together with fifteen other business agents of various unions, was indicted May 26 by the special building grand jury on charges of conspiring to extort money. Amounts of money said to have been involved in the alleged extortions amount to about $30,000.

Southern Pine Orders Almost Double in Six Months

Orders on hand at Southern Pine lumber mills have almost doubled since the first of the year according to reports made to the Southern Pine Association by its subscribers. On Jan. 1 orders on hand averaged 607,590 ft.b.m. per mill, while on May 1 an average of 1,206,620 ft.b.m. was reported, representing an increase of 99 per cent. The average stocks held by Southern Pine subscribers uncovered by orders and available for shipment on the first of the year were 6,260,211 ft. b.m. Each month since has witnessed a gradual diminution, and on May 1 reports showed an average of 5,157,408 ft. b.m., a decrease of 18 per cent from the available stocks on Jan. 1.

Builders Paid High for Borrowing Privilege, Committee Hears

Testimony to the effect that builders paid large bonuses to banking institutions for the privilege of borrowing money, often having to buy undesirable real estate in order to make sure of securing it, was given last week before the Lockwood committee, investigating the building situation in New York City. One witness, a representative of a mortgage loan brokerage firm, told the committee that in negotiating a $210,000 loan for five years at 5½ per cent the borrowers paid to the insurance company's brokers a 3 per cent fee in addition to being forced to purchase a three-story brick house they did not want.

Another instance was cited wherein a builder was loaned $240,000 for five years at 6 per cent, the money being handed to the borrower in Liberty bonds at par, which at the time of the loan had a market value of about 95. In some instances it was testified only two-thirds of the loan was turned over to the borrower, the remainder being deducted as a bonus.

Some of the best known of the New York City banking houses, insurance companies and mortgage brokerage firms were said to subscribe to such practices.

New Immigration Law Goes Into Effect

The new immigration law, recently passed by Congress and which restricts immigration within a year to 3 per cent of any nationality already in the United States, went into effect June 3. The number of aliens that will be allowed to enter the United States within the year after the law becomes effective is 77,206. Provision is made, however, that as high as 20 per cent of the total may be allowed to enter during any one month.

Federal Reserve Board Notes Marked Building Activity

In the Federal Reserve Board's June 1 analysis of general business conditions the following reference is made to building operations:

District No. 1 (Boston) — Contracts awarded amounted to about $16,700,000 in April, as compared with $12,200,000 in March, an increase of 37 per cent. About $6,500,000 of the April total was for residential purposes, as compared with $4,300,000 in March.

District No. 2 (New York)—Contracts awarded during April had a total value of about $52,100,000, as compared with a value of $30,900,000 for March, an increase of 69 per cent. Residential building amounted to $18,100,000 in March and $28,600,000 in April.

District No. 3 (Philadelphia)—Contracts totaling $15,100,000, of which $6,300,000 were for residential purposes, were awarded during April, in comparison with March awards of $14,100,000, of which $6,000,000 were for residential purposes.

District No. 4 (Cleveland) — Contracts awarded during April totaled about $34,800,000, as compared with awards amounting to $32,700,000 in March. Of the April total only $9,100,000 was for residential purposes, as compared with $11,400,000 in March.

District No. 5 (Richmond)—Permits for new buildings in twenty-three cities totaled 1,638 in April as compared with 1,718 in March, the value of this new construction being $13,594,575, the highest monthly figure ever recorded for the group of cities. This was due to the inclusion of one industrial project which will cost $6,000,000.

District No. 7 (Chicago) — Contracts awarded during April totaled $53,700,000, of which $13,000,000 were for residences, as compared with a total of $37,400,000 during March, of which $9,300,000 were for residences.

District No. 8 (St. Louis)—In five cities there was an increase in number of permits during April, but their total was less than in March.

District No. 9 (Minneapolis)—Nine cities issued 2,868 permits, valued at $5,606,011 during April, as compared with 1,639 permits, valued at $2,621,591 during March. This increase in building activity is accounted for almost entirely by an increase in the permits issued for the construction of small buildings.

District No. 10 (Kansas City)—Reports from seventeen cities show a total of 2,668 permits issued in April, as compared with 2,778 in March.

District No. 11 (Dallas)—Nine cities report 2,588 permits, valued at $5,633,649, issued in April, as compared with 2,331 permits, valued at $5,190,191, issued in March.

District No. 12 (San Francisco)—The value of building permits in twenty cities amounted to $19,907,621 in April in comparison with $18,542,835 in March. In Southern California activity approaching a building boom is in progress.

Offer $1,000 for Lumber Saving Machinery or Method

A prize of $1,000 is offered by the National Lumber Manufacturers' Association, Washington, D. C., for the best new method, new machinery or new device which in practical application or use will result in an appreciable saving of labor, time, material and expense when applied to present manufacturing processes in the lumber industry. The purpose of the contest is to promote the reduction and elimination of preventable waste in the production of lumber, and to develop more efficient utilization of unpreventable waste in the lumber industry.

Bureau of Mines to Investigate Cement, Clay Products, Etc.

The Bureau of Mines will receive a supplemental appropriation of $35,000 for "scientific and technologic investigations concerning the mining, preparation, treatment and utilization of heavy clay products, cement, feldspar, slate and other non-metallics." The item was not seriously questioned in the House, but the Senate committee eliminated it from the bill. The committee was urged by Senators Pomerene, of Ohio; Underwood, of Alabama, and McNary, of Oregon, to allow this assistance to be extended to the non-metallic industries. The Secretary of the Interior, in a letter to the chairman of the Committee on Appropriations, urged that the appropriation be allowed.

In view of the very general demand for the character of the work to be undertaken with this appropriation the committee withdrew its objection, and the Senate approved the item as it passed the House, thus insuring its retention in the bill.

Government to Test Legality of Trade Association Activities

The attitude of the Federal administration toward the trade associations of the various industries has been made clear by the recent announcements of the Attorney General of the United States and the Secretary of Commerce. The Attorney General has given notice that he will push a test case against one of the open-price associations, and has indicated that there will be neither a drag net thrown over all the associations nor wholesale indictments. Secretary of Commerce Hoover has asserted that the purposes and actions of the vast majority of national associations are a constructive contribution to public welfare. "Their activity in promotion of better business practices, advancement of technical processes, simplification of production, standardization of quality, extension of foreign trade, commercial arbitration, etc.—all make for more efficient industry and business," said Secretary Hoover.

Philadelphia Has Brick Conference

Conforming to a resolution adopted at the New York Convention of the Common Brick Manufacturers' Association and the National Brick Manufacturers' Association, to inaugurate in each locality a movement for improving conditions in the brick industry, both as to the art of making and laying, architects, engineers, mason contractors, bricklayers, hodcarriers and building laborers and the manufacturers of brick and producers of other materials used in connection with brick work, met recently in Philadelphia. The meeting was presided over by Henry T. Shelley, chief engineer in charge of sewer construction with the Bureau of Surveys in Philadelphia.

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Construction Conferences Held In Many Cities

Following the national construction conference held in Chicago, March 2-3, the National Federation of Construction Industries, through its central direction committee, has been at work with various municipal, state and federal officials as well as construction associations and chambers of commerce, endeavoring to bring about local conferences of building construction interests, which will stimulate construction activity and look toward its reestablishment on a sound economic basis. Through the activities of the association many local conferences have already been held. Evidences of interest in the stabilization program have been received by the National Federation of Construction Industries from at least 69 different chambers of commerce, commercial clubs and boards of trade.

Unemployment in Britain Least in Building Trades

(London Correspondence)

The building were the only trades in which employment was fairly well maintained during April. The percentage of unemployment among all trade union members was 17.6 on April 30. The percentage of unemployed among 12,000,000 workers insured under the Unemployment Insurance Act rose from 11.3 on March 24 to 15 on April 29. Workers resigistered as unemployed on April 29 were 1,854,000, made up of 1,261,000 men, 448,000 women and the balance of unskilled girls and boys. Five hundred twenty-four thousand men and 553,000 women were on short time. Nine hundred thousand workers had their wages reduced on the sliding scale basis, including railway men, whose wages came down by 4s. Workers engaged on civil engineering constructional work had their wages reduced by 2d. to 4d. per hour.

Slight Increase in Unemployment

According to an estimate recently made by the U. S. Bureau of Labor Statistics there was an increase of unemployment in May over April of about one-half of one per cent.

Ohio Road Building to Await Lower Freight Rates

State Highway Commissioner Leon C. Herrick of Ohio has announced that no further awards of state road improvements will be made until the proposed readjustment of freight rates on road building materials is made. Mr. Herrick expects a reduction in such rates as the high freight rates are an impediment to road construction in the state. A letting which was scheduled for June 24 will be postponed indefinitely. He believes that contractors have the same idea that freight rates will decline as there was a reduction of approximately 11 per cent on the prices of contracts on the letting May 27 under the estimated cost made by the highway department engineers. The entire letting of May 27 called for $5,000,000 by the engineers' estimates, whereas the low bids aggregated $484,000 below the estimates.

Pennsylvania Soon to Open Bids on 84 Miles of Highway

The Pennsylvania State Highway Department will receive bids on June 21 and June 22 for the construction of 84 miles of highways of a durable type. Bids for the construction of 41½ miles will be received on June 21 and for 42½ miles on June 22. The mileage in each case is divided among sixteen projects. Specifications require that bids be submitted on one-course reinforced concrete on 53 miles of the total mileage.

Current Lumber Costs

Lumber costs are going down in some sections of the country at least, according to recent reports of the large associations. The Southern Pine mills report an average cost of $24.22 in February, the lowest since May, 1919. This is a considerable reduction from the peak month, December, 1920, when it was $37.27 per M. ft. b.m. Southern pine is selling now at an average of about $22.50 per thousand.

Cost of dressed lumber in North Carolina for March, 1921, is given as $31.02, compared with $35.88 in February. The average for 1920 was $44.22; for 1919, $38.13; for 1918, $33.95; for 1917, $23.56 and for 1916, $18.97.

Michigan and Wisconsin lumber mills do not, however, show such reductions at present, although during April in the northern woods, the heaviest declines were made in wages that have appeared during any one month. Average production costs in the northern woods as of May 1, 1921, are above $40 with lumber selling at from $41.50 to $42.50 per thousand.

On the West Coast the average total cost of manufacturing lumber in January was estimated as $25.75 per thousand feet, with total sales price averaging $25.56. Douglas fir is now selling at about $18 or $19.—*National Lumber Bulletin.*

Open-Shop Plan Gains in Building Industry

A decided tendency to adopt open shop methods of construction because of deadlocks following attempts at settlements in wage disputes, is noticed within the past few weeks. The decision of building trades employers to sign union agreements only upon condition that wage scales be reduced and an equally firm determination on the part of building trades mechanics not to accept reductions in wages, have made it apparent that a resumption of any considerable building is possible only through employment of non-union mechanics and labor.

Attempts at arbitrating the question have been tried in many cities both large and small, though as yet arbitration has apparently failed with a few notable exceptions.

The Illinois Society of Architects recently sent a communication to the contractors of Chicago urging the establishment of open shop in the building industry. The letter also emphasized the fact that before any wage agreement was signed between employers and employees in the building industry the public at large should have a voice in fixing the wage schedule and the working conditions.

An attempt is being made by the builders and union men of Newark to reach an amicable agreement, the mayor of that city, in the public interest, having taken a hand in the proceedings. Informal discussions of the situation have been held, but with no result so far. In Cleveland there is also a possibility of a conciliation board settling the wage situation, the board to consist of seven each of representatives of employers, labor, and the public. Judge J. J. Hahn has been selected as arbitrator of the wage situation at Providence, R. I., and is now hearing arguments of representatives of the master builders association and the bricklayers union. The carpenters and joiners union of Rockford, Ill., has also named an arbitrator and it is understood the employers' representative will soon be selected. In Kansas City, Alexander Maitland, president of the Kansas City Bridge Co., has been chosen chairman of the committee of arbiters who will decide points in disagreement between representatives of union labor and building contractors. On the arbitration board are another engineer and a clergyman.

In Indianapolis a recent announcement was to the effect that all the building trade council members on strike with the exception of the steamfitters had returned to work, pursuant to a decision previously reached.

One of the most recent of the large strikes in the building industry to be noted is that in Pittsburgh, where on June 1 approximately 1,000 workmen in the building trades walked out. The craftsmen in eighteen unionized trades refused to work on the terms laid down by the building construction employers association, which included a reduction in wages and radical changes in working conditions.

In Davenport, Iowa, it has been reported that sheet metal workers settled their differences with employers and signed up a new agreement calling for a 90c. an hour scale. Meetings between the allied building trades and the master builders are being held, and it is believed that an amicable adjustment can be made on a basis of between 85 and 90c. per hour.

O and S Dependable Is New Crawling Tread Crane

Among the latest crawling tread cranes is the O S Dependable, a crane of 7 and 12-ton capacities manufactured and sold by the Orton & Steinbrenner Co., Chicago and Huntington, Ind. The superstructure of the crane is proportionately identical with the O & S heavy standard-gage rail types, and the crawling tread is a development of the creeper used in military tanks. The tread links and sprockets are of cast steel and the chain idler rollers are bronze brushed with a patented pressure lubricating system. Each tread is supported between the drive sprockets and the idlers by four pair of idler rollers, each pair of which is carried in an equalizing strut backed by heavy coil springs. When crossing railroad tracks, or other obstacles, the rollers will tilt as much as 6 in. from the horizontal. The crane is able to climb a 30 per cent grade in soft ground. The tread links are reversible and so designed that the ends overlap, guarding against the entrance of foreign material.

O & S CRAWLING TREAD CRANE

Equipment for the crane may be varied to suit working conditions, and includes orange peel or clam shell bucket, electro-magnet, pile driving attachment, fall block for heavy loads, etc. The smaller of the two models is equipped with a ¾-yd. clam shell bucket, a 30-ft. boom and in excavating and material handling duties does its work easily within a 30-ft. radius. The 12-ton type has a boom of 35 ft., though in either size the boom may be lengthened.

Seek Reduction of Rail Rates on Construction Materials

Uncertainty as to railroad rates on road and building materials probably will be removed as a result of a conference held last week in Washington between railway traffic executives and representatives of these industries. The presentation was heard by George Ingalls, chairman of the traffic executives' committee for the Eastern territory; L. J. Spence, chairman of the committee for the Western territory and Lincoln Green, chairman of the committee for the Southern territory. It was argued that the railroads, as well as the industries, would benefit more by lower rates in that a much greater tonnage would be handled. Under present conditions, it was declared that substitution of local materials is going forward at a rapid rate, to the detriment of manufacturers, and carriers. Others concerned are affected, since these materials frequently are inferior, but their use is forced by the prohibitive transportation charges on better materials.

The representatives of the railroad executives gave no indication as to whether or not they would recommend a reduction in rates, but they promised to give the matter immediate consideration. They pointed out the seriousness of the question, since the commodities under discussion furnish 20 per cent of all railroad freight tonnage.

Hetch Hetchy Strike Ended

The strike of tunnel workers on the Hetch Hetchy project in California which has been in effect since last August, although the work has never been closed down, has been officially declared off by the Hetch Hetchy branch of the International Union of Mine, Mill and Smelter Workers. The understanding is that striking employees will be employed without discrimination but that contractors and superintendents will not be expected by the union to limit their employees to union men.

The work has been progressing of late at a good rate of speed and the records of advance made at the several headings are steadily increasing. There is every indication that the contracts will be completed within the time limit originally prescribed.

Titan Develops Two-Yard Sub-Grade Truck

To meet a demand for a motor truck of medium capacity to be used where haulage over subgrade is necessary in road construction work, the Titan Truck Co., Milwaukee, Wis., has developed what it calls a 2-yd. subgrade truck, the essential features of which are the short wheel-base and the use of large-size pneumatic tires. Makers of the truck claim that the distribution of the load is such that 80 lb. per square inch is all the pressure exerted upon the subgrade. The cord tires are 36 x 6 in. in the front and 42 x 9 in. in the rear,

the total carrying capacity of the tires being 14,400 lb.

The body is made of steel throughout and in two compartments. It is fitted with either an underneath hydraulic hoist with a dumping angle of 45 deg., or a Titan patented mechanical hoist with a dumping angle of 55 deg.

Record Week in Contracts Let

The value of contracts let during the past week, as reported in *Engineering News-Record*, totalled $44,922,017, the record week of the year and 60 per cent in excess of the contracts let for the corresponding week of 1920.

Ohio Lets Road Contracts Worth $3,802,172

Construction of more than forty projects, to cost a total of $3,802,172, were authorized during the past week by the Ohio State Highway Department, practically all of the projects for the construction of which bids were received on June 2, being put under contract.

The contracts cover the construction or reconstruction of 113 miles of highways. The largest contract was for the construction of 3.02 miles of monolithic brick, the contract price being $458,953.

Wire Scratch Brush Used in Cleaning Building Stone

Five hundred and twenty square feet per day was the average in cleaning the face stone of the Hanna Building in Cleveland by the Haskins type H6 equipment, which is a wide scratch brush electrically driven, manufactured and distributed by the R. G. Haskins Co., Chicago. Four machines of this type were used on the building, each making the foregoing average. The contractor estimated that these machines were doing the work normally requiring 16 men. The same equipment is used for cleaning form marks on concrete.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.33	−$4.00	$4.50	$3.23	$3.51	$4.65	$4.35	−$4.90	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65-5%	45%	58½%	51.9-5%	29%	49.80	−47½%	5%
Cast-iron pipe, 6 in. and over, ton	54.00	59.22	−65.00	−59.10	−62.80	70.00	85.90	−70.00	75.00
Concreting Material:									
Cement without bags, bbl	2.80 (dc.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	+3.48
Gravel, ¾ in., cu.yd	2.50	2.80	3.50	−2.25	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	−2.25	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	−2.50	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	40.00	50.00	55.00	−37.00	47.00	27.00	25.50@28.50	120.00
Lime, finishing, hydrated, ton	21.00	22.50	27.50	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl	3.30	1.60	3.00	1.65	2.00	−3.10	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	−12.00	−14.50	12.00	−17.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	− .092	.09	.12½	.11	.15
Hollow partition tile 4x12x12, block	....	.15	.13	.096	− .092	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal	.80	+.72	.90	+.89	.91	.95	+.96	.79	+.84
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.40@.50	.50	.37½@.50	.50@.55	.50	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

There seems to be an impression in the steel industry that prices are coming down. Chicago re-sale interests are shading prices on structural shapes, bars and plates. We quote structurals in Atlanta at $4, instead of $4.25, and in San Francisco at $4.80 instead of $5. The price of cast-iron pipe is gradually going down. For example, although $62.80 is the formal quotation in Minneapolis large quantities are obtainable at $57.80, while St. Paul last week placed an order for 494 tons of 6-in. at $54.75 per ton, f.o.b. St. Paul.

Common brick is down 50c. in Atlanta, $1 in Minneapolis. Hollow tile is down in Minneapolis and Montreal. The rise in linseed oil continues in Montreal, Atlanta, Chicago and San Francisco.

The downward movement of wages in Montreal is shown by the following comparison of present hourly rates with those of a year ago: Bricklayers, 90c., last year $1; carpenters 65c., against 75c.; roofers 50c.; against 70c.; painters 60c. against 65c.; plasterers 75c., against 80c.; plumbers 60c., against 85c.; tilelayers 60c., against 70c.; laborers 35c., against 45c.

The employment situation in Seattle shows some improvement since the reopening of street and road work and the resumption of lumbering and logging activities. The strike in San Francisco building trades is still on, builders announcing that they will resume operations on June 13 on an open shop basis with wages reduced 7½ per cent from the former schedule. The Chicago controversy was submitted to arbitration on June 4.